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JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior,
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MEMORY ORGANIZATION IN THE AGED*

Syracuse VA Hospital and State University of New York Upstate Medical Center

HOWARD FRIEDMAN

A. INTRODUCTION

Werner's genetic conceptual framework (9) has been applied broadly and fruitfully in the understanding of the structural aspects of mental development. His general developmental law, the conception of steadily increasing differentiation and hierarchic integration as the essence of all organic development, has less frequently been used in an experimental fashion with the obverse of development: i.e., retrogression or involution. Studies in this area have dealt primarily with attempts to define and comprehend the phenomenon of regression as it is exemplified in a variety of psychopathological and neuropathological conditions (1, 2, 3, 4, 6, 8). Rochwarg (7) has demonstrated the usefulness of the genetic framework in an investigation of the structural aspects of perception in healthy aged subjects. His review of the literature pointed to an involution in the perceptual process in the aged that parallels the decline observed in physiological processes, sensory and motor functioning, intellectual abilities, and overall psychological functioning. Using Friedman's genetic scoring system with the Rorschach Test (2), he found evidence to support his major hypothesis: ". . . in the process of normal aging there is a reversal in the developmental pattern of perception away from the maximum hierarchic integration and organizing capacity characteristic of adulthood."

The present study is concerned with attempting to comprehend the immediate memory functioning of aged subjects within Werner's conceptual framework. Decline in immediate memory has been amply documented (5), and the question is whether or not this change can be described in terms of a reversal in the developmental pattern of memory. Werner has emphasized the causal relationship between the growing capacity for retention and the developing ability of the child to organize material to be retained. As a consequence of a lesser degree of differentiation and hierarchic integration, younger children tend "to apprehend and to reproduce the material in continuous, chain-like wholes" (9, p. 165). Older children, on the other hand,

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apprehend and reproduce material "in patterns in which parts are related to one another and to the whole" (9, p. 165). Thus, Werner observed that when the number of digits presented to subjects greatly exceeded their capacity for retention, the amount of material retained by older children and adults was closer to the individual's capacity than was the case in younger children. The findings were interpreted in terms of the inability of the developmentally immature subjects to build a continuous whole, whereas the more mature subjects could organize discrete items for retention.

If, then, the decline in immediate memory function with senescence can be understood in terms of a loss in differentiation and hierarchization, an involution of development as it were, there should be a qualitative difference in the levels of memory organization between an aged population and a comparable group of younger subjects. This could be reflected in a quantitative measure: compared to individual capacity levels, the amount of material retained by the aged group would be significantly less than that retained by the younger group when material is presented that exceeds the individual's capacity.

B. SUBJECTS AND METHOD

Local senior citizen clubs provided a number of physically healthy, active members who volunteered as subjects. A group of young subjects was obtained from volunteer hospital employees and college students. All potential subjects were administered the vocabulary test from the Wechsler-Bellevue Scale, Form I, and were required to perform a preliminary learning and retention task consisting of learning four pairs of nonsense syllables to a 100 per cent correct criterion within 30 trials. This combination of tasks provided an estimate of intellectual functioning based on a measure, vocabulary, least sensitive to aging; and also provided further screening for possible organically based learning deficits that could reflect some undiscovered pathology, particularly in the aged group. Those subjects who were insufficiently motivated to complete the preliminary tasks or could not learn up to the criterion were excluded from the investigation. Thus, the two final pools of subjects from which matched pairs were selected for statistical analysis were composed of a young adult group (Y) of three male and 10 female subjects, ranging in age from 20 to 34 years, and an aged group (A) of four male and 10 female subjects between 60 and 81 years of age. In no case was there a statistically significant difference between an A group and its matched Y group with regard to vocabulary test scores.

By means of a paper belt and memory drum, randomized alphabetic letters,

four through 12 letters in a series length, were presented singly and at the rate of one letter per second. The lengths of the trials, four through 12 letters, were randomized also and replicated twice so that there were 36 series of letters in all, from four through 12 letters in length, with each series size represented three times. The subjects were instructed to await completion of the presentation of a series of letters and then to repeat verbally as many letters as remembered in the order of presentation. They were informed that some series of letters would be too long for complete recall, were not informed in advance of a particular series length, and were not given any knowledge of results. Intertrial intervals were approximately 15 seconds, long enough for the subject to recall all that was possible.

To understand the findings within the genetic framework utilized, it is necessary first to establish an individual capacity level for each subject. There are three possible criteria for defining such a level: (a) the largest series of letters completely recalled without error in at least one of the three trials (Criterion 1), (b) the largest series perfectly reproduced in two of the three trials (Criterion 2), and (c) complete recall without error in all the three trials of a particular length (Criterion 3). In order to examine the subject's performance when capacity level was exceeded, the number of recalled letters in correct order for each series larger in size than the individual capacity level was recorded. Thus, a subject with a capacity level of five would, because of three repetitions of the series, have a potential maximum of 15. If his scores for three trials of six letters, three trials of seven letters, etc., were each divided by his potential maximum of 15, the ratios obtained would yield percentages of correct ordered recall from presentations of material that exceeded individual capacity level by one through seven letters.

C. RESULTS AND DISCUSSION

For each of the three criteria for capacity level, all the possible pairs of subjects, matched for sex and capacity level, were selected for statistical analysis. Table 1 presents the mean percentages of material recalled in the two groups as capacity level for each individual is exceeded by series lengths that increase in size by one and more letters. Since, under Criterion 3, the maximum capacity level for any matched pair was six letters, this permitted the inclusion of data derived from the performance under conditions in which individual capacity was exceeded by six letters for all pairs of subjects.

Using the Criterion 1 definition of capacity level, analysis of variance reveals a between-groups F of 6.38 (df 1, 16) that is statistically significant ($p < .05$). Thus, as the series of letters exceeds in size the individual's

capacity level by one through five letters, the A group recalls significantly less material than the Y group. There is a similar finding when Criterion 2 is used to define capacity level. Analysis of variance indicates in this case a between-groups F of 11.92 (df 1, 18) that is statistically significant ($p < .01$). Further, with Criterion 2, the recall of both groups decreases significantly as the length of the series presented increases from one to five letters beyond individual capacity (F 4.88; df 4, 72; $p < .01$). The findings with Criterion 3 are similar to those with Criterion 2. Both groups drop significantly in amount of retained material as series length exceeds individual capacity

TABLE 1
MEANS OF PERCENTAGES OF RECALLED MATERIAL FROM SERIES LENGTHS
EXCEEDING INDIVIDUAL CAPACITY

	Criterion 1		Criterion 2		Criterion 3	
	A	Y	A	Y	A	Y
<i>N</i> (matched pairs)	2 male 7 female		2 male 8 female		2 male 4 female	
Capacity levels range	5-7		4-7		4-6	
Age range	60-81	22-34	60-76	20-34	61-71	20-34
+1	44.3	45.3	54.5	66.1	73.3	80.5
+2	27.1	49.7	56.5	63.4	56.8	69.2
+3	21.4	48.2	30.8	55.2	51.0	74.7
+4	31.0	40.7	31.0	52.4	47.7	80.0
+5	21.9	40.7	35.5	49.8	35.2	49.0
+6					32.5	46.7

(F 5.44; df 5, 50; $p < .01$), and the A group consistently retains significantly less than the Y group once individual capacity has been exceeded (F 6.06; df 1, 10; $p < .05$).

In general, then, the two groups combined tend to perform with increasing error as the amount of material presented increases beyond each individual's capacity level. In the cases of Criteria 2 and 3, the results are statistically significant ($p < .01$); with Criterion 1 there is a trend in the same direction (F 2.16; df 4, 64; $p < .10$). Regardless of criterion of capacity level used, however, the A group was consistently and significantly poorer than its corresponding Y group when individual capacities were exceeded and the amount of material reproduced under the various conditions was compared to the individual's maximum capacity.

The findings are thus compatible with the conceptual framework adopted for this study. In memory ability, the functioning of the aged can be comprehended within a general developmental law and described in terms of reversal in the developmental pattern of memory with concomitant re-emergence and importance of genetically lower levels of organization.

The importance of the organizational factor in such findings is attested to by taking the same experimental results and scoring without consideration for correct order in reproduction. Thus, when the subject reproduced in any order any of the letters from a series that exceeded his capacity level, such letters were scored as correct and the score divided by the subject's maximum capacity in order to give a percentage figure. Analysis of variance of the data treated in this fashion revealed no significant differences between the A and Y groups using any of the criteria for capacity level. This finding highlights the importance of organizational level, for when individual capacity is exceeded the significant differences appear in organizational ability, as reflected in ordered reproduction, rather than in sheer amount of recall.

As with the structural aspects of perception, then, memory organization lends itself to understanding within a genetic framework that construes senescent performance as structurally less differentiated and hierarchically integrated than younger adults' performance.

D. SUMMARY

An attempt was made to comprehend the memory functioning of senescent subjects within the framework of a general developmental law that has proved useful in a study dealing with the structural aspects of visual perception in a similar population. The hypothesis was that healthy aged subjects, when compared to a matched group of young adult subjects, would function in terms of memory organization at a level that would reflect less differentiation and hierarchic integration than that possessed by the young adults. The expectation would then be that retention of presented material that exceeded an individual's capacity would be closer to such capacity level in a young adult group than would be the case in a group of aged subjects. All possible pairs of subjects, matched for sex and capacity level, were obtained from a pool of 13 young adult subjects, 20 to 34 years of age, and a pool of 14 healthy, active, aged subjects, 60 to 81 years of age. Three possible criteria for capacity level were determined, thus allowing for three sets of matched subjects with nine, 10, and six pairs, respectively. Randomized alphabetic letters, four through 12 in a series length, were presented singly. Series lengths were also randomized and replicated twice to provide 36 series of letters. Upon completion of presentation, subjects were asked to repeat the letters verbally in order of presentation. Analyses of variance indicated that, regardless of criterion of capacity level used, the aged group performed significantly poorer than the young group when the individual capacity level was exceeded by one through five or six letters. The importance of the organizational factor was highlighted

when the results were scored without concern for correctness of order and no statistically significant differences between the groups were observed. The findings could then be understood within a genetic framework that can describe senescent memory functioning in terms of reversal in the developmental memory pattern with concomitant re-emergence of genetically lower levels of organization.

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ON THE MEANING OF TIME IN LATER LIFE*¹

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A. INTRODUCTION

In the time that it takes to read this paragraph, one might have conducted a complete data-gathering operation involving the use of a tachistoscope, stopwatch, or electrical timing device. The measurement of human behavior with respect to short temporal durations has long been a familiar technique in psychological research. Time is kept by the psychologist in his modest stopwatch or elaborate timing system. The subject is permitted to use a certain small quantity of the timekeeper's commodity: e.g., for reacting to a stimulus or attempting to replicate a specified short temporal duration.

When the study has been completed, the subject is "on his own time" again. It is one's "own time" that will be considered in this paper, especially the time one organizes and experiences when one is in the later years of one's life. In recent years an increasing number of psychologists have moved away from the role of a timekeeper to that of a participant-observer in the individual's own organization and use of time. In this general approach, time is "kept" (or "created") by the subject, who permits the psychologist to enter partially into his temporal experiences and constructions. This approach is fraught with difficulties, for the investigator has relinquished much of his external control in order to learn how the subject goes about the process of controlling, organizing, and planning when he is left pretty much to his own devices. It is more difficult, if not impossible, to achieve the same precision when, let us say, one is attempting to learn how a centenarian is weaving together strands of past, present, and future, than when one is limiting one's interest to how well he could reproduce a 20-second time interval. So our research involves a constant struggle to do justice both to the richness and complexity of human temporal experience, and to scientific requirements for operational definitions, replicable procedures, and adequate, unbiased analysis of the findings. The methods, concepts, and conclusions that will be sketched

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rather briefly in this paper should be regarded as quite preliminary, tentative, and selective. Studies of personal time are considered to be particularly important in developing conceptual frameworks for understanding personality in later life [e.g., Kastenbaum (25, 26)].

To keep this paper within reasonable bounds, nothing will be ventured about the biological correlates of temporal experience, and very little about psychoanalytic conceptions of time or differences associated with socioeconomic variables. These omissions are necessary because the biological, psychoanalytic, and sociological approaches to the understanding of time deserve extensive consideration in their own right.²

B. TEMPORAL EXPERIENCE BEFORE ADVANCED AGE

What are the meanings of time in later life? For perspective on this question let us take an earlier point on the life-span, and see what shape has been given to temporal experience before advanced age. Adolescence is a logical choice, both for its intrinsic interest and for the happy circumstance that we know or think we know a little more about temporal experience in adolescence than at earlier and later periods. The discussion here is limited to adolescents in our society in our own times.

The typical adolescent has already developed many resources for coming to terms with the temporal dimensions of experience. He is able to distinguish between his realm of personal time and the realm of public time that moves unidirectionally, continuously, and in fixed units regardless of his own state of being. Within his realm of personal time he recognizes a predominantly biological periodicity, such as in the activity-and-rest cycle, but also an arena of fantasy where he can engage in free play with time. In his fantasy the adolescent can suspend time altogether, or project himself selectively back and forth in time without regard for the steady unidirectional pulse of public or astronomical time.

Of particular importance is the fact that the adolescent has come into the possession of most if not all of the specific intellectual operations that characterize the adult human being [e.g., Piaget (32)]. He is capable of thinking about thought, of taking future contingencies into account, of liberating himself from the demands of the present situation by utilizing that which

² For illustrative biological approaches, see Gooddy (12), Davis (8), and Campbell (4). Among the many psychoanalytic contributions, one might note those of Dooley (9) and Bonaparte (2). LeShan (30) and Graves (13) are among those who have investigated social class correlates of temporal experience. Reviews of time perspective in general have been offered by Wallace and Rabin (35), Fraisse (11), Wohlford (37), Kastenbaum (21), and Craik (6).

is *not* here-and-now. Obviously, a person can manage to detach himself so much from the here-and-now situation that his use of futurity takes on a predominantly escapist quality. But in general, as Hartmann (14), Piaget, Werner (36), and many others have observed, the ability to scan the future is a milestone in the early development of the normal individual.

There are at least two lines of research that indicate that the future has become more "real" for the adolescent than it was for the child. Some investigations have indicated that the adolescent projects himself further into the future than does the child, so one might say that the future is more "real" in that there is more of it, and it seems to have increased influence upon the individual's present behavior [see Wallace and Rabin (35), and Lhamon, Goldstone, and Boardman (31)]. The other, and perhaps even more relevant aspect, might be illustrated by results of an unpublished study by the present writer. In this study the author selected "normal" children and adolescents in groupings that ranged from age 10 to age 19 (total sample equalled 75). Three brief and fictitious, but plausible, case histories were devised. Each described a 15-year-old boy, in one instance a creative and admired leader, in another instance a boy who had been in trouble with authorities for a series of minor delinquencies, and in the third instance a fairly typical adolescent with no salient creative or delinquent characteristics. Ss were asked to make several judgments about each of these young people, judgments pertaining mostly to what they would be like when they grew up. But the author was most interested in one particular judgment: namely, how certain the subject was that his prediction would come true. Here it was found that with increasing age from late childhood through adolescence there were increasing expressions of *uncertainty*. The child was pretty sure that he knew what the future held; but the adolescent felt that the future could go in a number of different ways: one could judge and plan, but the future remained a zone of contingency.

This writer suggests that there is an intimate relationship between a sense of genuine futurity and a sense of contingency. The adolescent, better than the child, appreciates the qualitative difference between time that is past and time that is yet to come and might bring forth new events. This sense of the future as a qualitatively different kind of time also stands in contrast to cyclical views that have prevailed in some cultures; that is to say, time is regarded as a wheel that provides a sort of stationary motion—movement that, in the short or long run, does not go any place. Another way of putting it is that the adolescent is aware of the directionality of time.

The sense of forward motion is linked with the adolescent's idea that he

is on the verge of coming into "his own time." At the moment he is still partially controlled by the parental generation, but soon he will be enfranchised to use his time as he pleases (or, so he thinks!), and to fill this time with the really significant events and experiences in life.

Yet research findings have indicated that the sense of forward motion in time is not necessarily associated with planning and organization of future experiences, particularly in the remote future. Study after study discloses that it is chiefly the near future, the next few years, that occupies the thoughts and emotions of the so-called typical adolescent. Furthermore, the keen sense of forward motion also seems to exclude for many young people an appreciation of the past, including their own.

One investigation of 260 high school juniors involved a battery of time perspective procedures (17). It was found that the next few years of life were crammed with expectations, but that the later years of life—here defined as about age 25—were considered much less interesting than the next few years; and the very advanced years—about age 35—were almost devoid of content. We seemed to be dealing with a poverty of thought concerning the later years of life, and also with a definite resistance to dwelling upon what was considered to be an unpleasant zone of the life-span that contained no significant values. In the same study it appeared that many adolescents also were quite uncomfortable with their own past, and were attempting to put it out of mind. There was the implication that both the past and the remote future were seen as vague, confusing zones in which one could not be sure of one's personal identity, or could not be sure that one wanted the identity that these zones seemed to confer.

A second investigation confirmed some of these findings, and added the conclusion that an adolescent's sense of forward motion, as gleaned from his choice of static or dynamic time metaphors [see Knapp and Garbutt (29)], has no necessary relationship with his proclivity for extending his thoughts to the future, or imposing an organization upon the anticipated contents (18).

The results up to this point implied that many adolescents have a sense of hurtling rapidly toward a future that stands but a short distance away. What happens next? Will the adolescent reinterpret his life so that a new future looms before him, or will he eventually pass through what once was "The Future" and from then on have to look back over his shoulder? In other words, we might be dealing chiefly with a once-only phenomenon, the establishment of a personal future that is anchored to a particular point in time, or we might be dealing with the first of several futures that will be established by the individual as he continues to experience life. This question

will be considered later from the vantage-point of old age. For now, it is relevant to add the finding from another set of investigations, that adolescents and young adults who come from a variety of backgrounds and are engaged in a variety of career preparations tend to limit their scanning of their own life-span to the range of years approximately between age 12 and age 46; actually, age 46 is our highest figure, with the more typical upper limit being around age 35 (27).

Another word is in order about the use of the past in adolescence. In a separate investigation, the author asked 104 high school seniors to construct a story for each of 12 story-beginnings that were provided to them (22). The story-beginnings were divided conceptually into three sets according to the affective tone: a neutral set, a pleasant set, and an unpleasant set. Each set contained four stories. Here is a sample of matched story-beginnings in each set: "Wally and Carol were at the dance together . . ." (neutral); "Pete and Sally were at the dance together, having a miserable time . . ." (unpleasant affect); "Bill and Louise were at the dance together, having a marvelous time . . ." (pleasant affect).

Most Ss took all of these story-beginnings into the future. But there was a good deal of variability concerning whether or not the subject would also make use of the past. In the examples given, use of the past would mean that the story might include some information about what had been going on before Wally and Carol went to the dance. The emotional element, either positive or negative, produced more attention to the past than did the stories that were framed with neutral roots. Furthermore, the brightest students in this sample, as categorized by intelligence test scores, were much more likely to introduce pastness into their stories than were the least intelligent students.

What does all this mean? The line of interpretation offered here might take us closer to discerning possible differences in the meaning of time between adolescence and later life. It will be easiest to quote from the discussion section of this investigation:

The data suggest that the "easiest" way to develop a unified production or completed meaning from the introductory fragment (story-beginning) is to project into the future. Even the most minimal stories involved some projection into the future. This implication is supported not only by the statistical information reported above, but also by inspection of the stories. It is clearly evident in the type of story the writer has come to classify as "So-He-Went-Out-And." In this terse and simple form of meeting task requirements, the *S* merely appends to the meaning fragment another phrase or two which serves the purpose of closure. Typically, such stories are routine and unimaginative. They appear to reflect the operation of a

powerful drive toward the "principle of least effort" in dealing with this somewhat unfamiliar and perhaps uncongenial task. Here are two illustrations: "*Hal woke up and didn't have nothing to do. So he went out for a drive.*" "*Curt and Don met each other in the center of town early one morning, and so they went some place and hung around.*" Rudimentary productions of this type seem to move instantly into the future—without developing that future or elaborating upon the situation described in the root. By contrast, it is rare to find a rudimentary story that deals exclusively with the past.

The easy-way interpretation of futurity receives further support when the differences related to intelligence are considered. The brightest *Ss* conceptualized futurity no less frequently than did the dullest *Ss*, but gave a good deal more attention to the past. Thus, it would appear that with a higher grade of intellectual effort comes an increasing concern with antecedent conditions.

Affective set might be regarded as a factor that complicates the *S's* task: The affective tinge increases the stimulus intensity with which the subject must cope. Somehow, the task has become more significant or challenging. One way to accommodate the stimulus increment is to contain the affect within a psychological structure, such as a "time perspective." This alternative appears most likely to be taken by those who have relatively good cognitive skills, although doubtlessly other variables are important. Another alternative would be to discharge the stimulus increment in a manner that is irrelevant to the task: e.g., by motoric restlessness (foot tapping, wriggling around in the chair, etc.). The present study does not provide data regarding the latter alternative, although it would now be hypothesized that those who produced only simple bursts into the future when presented with the affective roots would be especially apt to discharge their tensions motorically.

If we take seriously the "perspective" in "time perspective," then it is apparent that there must always be at least two reference points and a relationship between the points. A person who thinks exclusively of the future, for example, does not have a strong future time perspective—he has no time perspective at all. It is the person who manages to keep past, present, and future in mind that has the opportunity of developing a genuine perspective.

From these considerations, then, it seems that "pastness" is a variable element in the construction of a time perspective. While it would appear that routine psychological development includes the activation of a future-scanning function, the past-scanning function requires additional cognitive or motivational factors on the part of the individual or special cues in the environment. To learn why some people develop a temporal perspective on life and others do not we would wish to give particular attention to the conditions upon which the appreciation of the past depends.

If a time perspective can serve to accommodate affect and, therefore, afford the individual an alternative to quick response and impulsive discharge of tension, then the person who is disinclined to consider the past

will tend to be deprived of this coping procedure. A previous study by the writer (17) suggested that most adolescents in a normal sample had an aversive, blocking-out reaction toward their personal past. The implication might be that one of the developmental tasks that still lies ahead for many adolescents is the ability to take "pastness" into account in elaborating a cohesive view of life. By contrast, the developmental task of the aged person might be to find a way of maintaining the future-scanning function. Neither the adolescent who ignores the past nor the aged person who ignores the future could develop or maintain a genuine time perspective, according to the present line of reasoning (22, pp. 198-199).

Two further comments will be offered to round off this sketch of personal time in adolescence. The tendency to ignore the later years of one's own life seems to be related, as we might expect, to fears both of aging and death. We have the impression, not yet adequately supported by controlled observation, that adolescents and young adults more readily express death fears than do elderly adults. If time is experienced by adolescents primarily in its directional aspect—an arrow pointing to the new events and the new self in the future—then death becomes a massive threat, the termination of a sequence that is still in process of development.

Along with the adolescent's heightened concern for futurity, he develops the ability to delay gratification. The work of Singer and his colleagues suggests that increase in the ability to delay gratification is associated with various other measures of ego development, including relatively mature Rorschach perceptions and behavioral indices of impulse control [e.g., Singer (34)]. The juvenile delinquent, the culturally disadvantaged, the mentally subnormal are among those adolescents who tend not to develop adequate capacity to delay gratification.

C. DELAY OF GRATIFICATION IN LATER LIFE

Wolk, Rustin, and Scotti recently devoted a paper to the so-called "geriatric delinquent" who acts out his conflicts in criminal or socially undesirable forms (38). According to these observers, the geriatric delinquent is "dominated by the pleasure principle—orientation toward immediate gratification—frequently at the expense of long-range plans . . ." (38, p. 658). Such a person is thought to have suffered a breakdown in his ego control. Thus we have here the suggestion that delay of gratification and future planning diminish in at least one subgroup of the aging population, and that this constitutes an undesirable regression.

In a recent experiment, the author attempted to set up a simple analogue

to study delay of gratification comparatively in young adults and in aged adults who are normal, self-sufficient members of the community (33). Six hypothetical processes were raised as possibilities in advance of the investigation:

It might be ventured that delay of gratification remains strong in later life for several reasons:

1. Because delay of gratification has been practiced for so many years, it has become a well-established habit and, therefore, should be resistant to change and ensure its own perpetuation.

2. The normal individual will have utilized delay of gratification with success. He knows from favorable experience that patience and planning frequently will bring him what he wants.

3. Many instinctual drives which impel one toward impulsive behavior early in life have passed the peak of their urgency. Furthermore, these drives will have become more or less integrated into the total personality structure. Therefore, in later life one should find it easier to delay gratification because there is reduced pressure for urgent relief.

One might also predict, however, that delay of gratification will weaken in later life for such reasons as the following:

1. There may be a general decline with age of the sensory and integrative capacities of the individual. Advanced senility would be an extreme case of this decline, but even more moderate impairment might significantly reduce ability to delay gratification.

2. Instinctual drives previously under the control of developmentally higher structures may "break the leash," so to speak, and emerge as urgent goads to direct gratification of needs.

3. The aging individual may perceive that time is running out on him. With this thought in mind (consciously or unconsciously) he might decide that there is no point in continuing to delay gratification. It is important to note that if this factor is the dominant one, then the abandonment of the "waiting game" need not be viewed as a pathological regression. Rather, it would represent a realistic adaptation to a new situation in life (33, pp. 282-283).

Results of the present study most strongly supported this last statement, that there is a decline in delay of gratification, but that the decline is related in some measure to the individual's new interpretation of his situation in life. As many elderly persons told us in the course of this study, there is no point in wasting time, in delaying, when so little time is left. It should be added that the elderly Ss in this investigation were all men in good mental and physical health who were living in the community and active in church affairs. So we have here the possibility that many elderly persons are less inclined than formerly to delay gratification, but that this change does not necessarily signify a pathological regression; instead, it may signify a new adaptation to a new life situation.

In this connection we might call attention to another subpopulation among the aged: The responsible citizen who established a lifelong pattern of denying himself luxuries and pleasures while working hard to raise a family and prepare for the future—only to arrive at last in that future with a sense of having been cheated of his long-delayed gratifications. He ends up embittered against life, possessing neither the pot of gold nor memories of golden days. Here, perhaps, is future-orientation and delay of gratification gone wrong, valuable components of normal development that have turned on their host.

What is lacking here? Perhaps it is the failure to subordinate the dimension of futurity within a larger perspective that includes a place for engrossment in the present and utilization of the past (23). Furthermore, this man's sense of futurity was forged relatively early in his life and was not allowed to modify itself by subsequent experience. He is growing old in the pursuit of a young man's future.

D. "OLD AGE" AS THE UNEXPECTED

Consider now the fate in later life of another tendency that shows up in adolescence. We have seen that most adolescents and young adults do not project themselves into their own remote futures—although it is possible that recent national attention to problems of aging might alter this situation. We now can add the finding that most patients at Cushing Hospital, according to their self-report on what we call the Past Futures Technique, also did not think ahead to advanced age when they were young, nor when they were middle-aged (28). And we can add the finding that in a limited sampling of middle-aged people there are relatively few who are inclined to project into the years that lie ahead of them (27).

This disinclination to take one's later years into account no doubt is related in part to negative social attitudes toward aging, which have been amply documented. But it may also be that a young person simply finds it very difficult to understand that some day he might *really* be old, or that his grandfather (or father) once *really* was young. The immediate situation and one's own limited experience provide strong evidence that "I am young" ("I have never been old"), and that "Grandfather is old" ("I have never seen him young"). By implication, then: "I will *always* be young," and "He was *always* old."

For some people, then, "old age" seems to be encountered *as if* it were unexpected. Clinical experience and some limited research at Cushing Hospital suggest that there is a subpopulation of elderly people who are thrown into an identity crisis when confronted with their situation (20). These patients

did not think about later life when they were young adults, and still do not regard themselves as "old," when they are ill and in their eighth decade. These people seem to have followed a life plan that relies upon the achievements, resources, and affiliations of their early years, with little provision for developing new goals or techniques of coping. Thus, they neither had a place for "growing old" in their early interpretations of futurity, nor the flexibility to add the dimension of aging to their time perspective as the years went by. Physical symptoms seem to provide these people with their explanation for what has happened to them. Since "old age" had no place in their personal time framework, its occurrence, if acknowledged, would strike like a mysterious, devastating thunderbolt from afar. Thus, instead of becoming "old," the patient "had a bad leg" that required him to curtail his activities. The patient in this way rescued himself from the brink of catastrophic anxiety by pinpointing a symptom that he could consider to be apart from his true and ageless self. The "true self" could now be regarded as having been battered by the world, but not mysteriously enveloped by "old age."

As one might expect, when in some instances the symptom was removed by effective medical and nursing care, the patient was thrown into a state of confusion. Unable to find any explanation that would permit him to retain a sense of self-consistency, he withdrew to a markedly decreased level of functioning. So it appears that a person who has never prepared himself psychologically for the later years of life—as, for example, by failing to include "old age" within his time perspective—may in advanced age be left without a firm sense of his own identity, having no ready alternative but some form of regression.

E. TWO MEANINGS OF FUTURITY

The last few points have had a somewhat dysphoric quality; so let us shift to an aspect of time that reveals the older person in a more radiant light. It seems to be the case that many older people are living in a sort of surplus time that extends far beyond the futures they envisioned when young. But does this mean that they are not able to deal adequately with the future dimension? In one investigation a distinction was made between personal and cognitive futurity (19). *Personal futurity* is bound to the individual's own life-span. From the vantage of his present moment of existence, the individual can look back toward a past that is his own personal history, and ahead toward a future that holds his own personal "destiny." Time has the quality of an intimate personal possession. *Cognitive futurity* is the orientation toward utilizing time as an abstract cognitive category for organizing and

interpreting experience in general. Time is a tool of the intellect. We attempted to learn if elderly people tend to suffer a loss in the use of both personal and cognitive futurity.

Personal futurity was studied by the Important Events Technique. The subject is asked to report the most recent important event or experience in his life, and the temporal distance between that event and the present time is ascertained. He is then asked for the most recent event prior to that, and, again, for the most recent event prior to that. These three steps into the past are followed by three steps into the future. *S* is requested to give his expectations for the next most important event in his life, and so on. *S* is free to give his own interpretation of what constitutes an important event. Cognitive futurity was studied with a story-completion technique similar to the one described earlier. The *Ss* were 24 alert Cushing Hospital patients, and an equal number of college students who were used not as a strict control group, but as a point for comparison.

There was clear evidence for a restriction of personal futurity, no matter how the data were analyzed. However, there was no corresponding decline in cognitive futurity. In fact, there was a tendency for the elderly people to construct more stories that were well integrated in comparison with the younger *Ss*. There was the hint that older people were likely to construct better integrated stories because they took the dimension of pastness into account more frequently than did the younger people. This result brings to mind the earlier investigation that implied that pastness is still a variable element in the adolescent's cognitive use of time (22).

This study, then, suggested that a limited or bleak outlook on personal futurity in later life does not necessarily inhibit the older person from making good use of futurity as a dimension in the organization of experience and that, in fact, he might possibly have improved his ability to put events into perspective because he has retained his facility with the past, a skill that perhaps develops most rapidly after adolescence.

F. LIVING IN THE PAST

Let us remain with this fascinating concept of "pastness" for a moment. When it is said that an old person lives in the past, often this statement is issued in a tone of irritation or derogation. Yet we have seen that the ability to use pastness is one that may have to be acquired through years of experience, and one that may serve significant functions. Robert Butler has emphasized a process of life review in which the normal aged person reintegrates his personality and prepares himself for death (3). One would like to see increased

experimental evidence for the existence or frequency of this process, but the suggestion at least is in the direction of positively evaluating a certain kind of past-centeredness in later life.

Perhaps what irritates us sometimes about an elderly person's past-orientation is our own reaction of having been snubbed. The present moment is consensual, public; we all share in it. We also have potentiality for sharing the future together; so the person who dwells on the present or the future has company. But when an aged person dwells on his past he is moving in a realm that is not directly accessible to us; we were not a part of it. Living in the past, then, tends to isolate the aged person from his younger contemporaries, and the effects may be the same as in any other form of isolation. When two or three centenarians get together to talk about old times that they shared, the past is brought alive into the present, and no longer has that solitary, private quality that we Americans tend to suspect and resent.

Furthermore, what we dislike in an old person's use of the past may be a particularly defensive or dulled quality that is linked not so much with past-orientation *per se* but with a withdrawal from the present. Some evidence in this direction was provided in a study by Fink, who found that elderly people who lived in an institution were more concerned with the past and less concerned with the future than were older persons who lived at home (10). Perhaps, then, we are reacting to some of the negative qualities associated with institutionalization rather than with normal changes in temporal orientation with age.

G. TIME AND DEATH IN LATER LIFE

Jung (16) and Cumming and Henry (7) are among those who have emphasized that preparation for death is a major developmental task for the aging person—indeed, for the second half of life. This significant concept is difficult to subject to experimental analysis. However, we might well expect that ideas of death would be closely related to ideas of time. One possibility is that time is felt to become of decreased importance as one ages either because one can do less with his time, or because the proximity of death overrules any realistic devotion to future prospects. This question is far from being settled. One investigation has found that no less than 50 per cent of a population of centenarians residing in the community retain personally significant future ambitions, and that at least half of this subgroup take these ambitions as serious goals that might be achieved with appropriate effort on their part (5). Yet clinical experience in a geriatric hospital suggests that time frequently decreases in importance in the lives of aged persons—an impression that is

supported to some extent by the observations of Henry (15) based upon aged persons residing in the community.

The observations made within the framework of clinical services to people who are not only aged but also ill and institutionalized further suggest that "one pathway of individual experience . . . is gradually to constrict and shallow out the personality so that when death does approach it is a smaller event, because it is terminating a life that has already become more modest in scope and released its hold: image of a dry leaf blown away by a gentle breeze, as contrasted with the burgeoning young tree uprooted by a violent storm. In slightly less fanciful terms, it is the difference between the directional flow of time (as in adolescence) with its prospective new events and experiences coming to an abrupt termination, and the cyclical repetition of routine and diminishing events simply not repeating itself anymore. . . . (For some aged persons, at least) time is less fascinating and precious; death less formidable and devastating" (24).

But still another viewpoint has been advanced recently that regards the possible reduction of interest in time as a predominantly defensive maneuver. Back argues that "consciousness of the future implies consciousness of death, and when transcending time the thinker also tries to transcend death. It would seem significant that exalted states, maximum experiences, mystical states, or drug-induced concepts typically are described as involving some feeling of timelessness, which is the real attraction of these states. . . . When so much effort is devoted to denying the reality of the importance of time as a concept, it should not be surprising that consideration of time as an important variable has been delayed and neglected" (1).

Back then studied a group of elderly people living in rural western areas and asked them, among other things, "If you knew you were going to die within 30 days, what would you do?" and "If you knew that everybody were going to die within 30 days, what would you do?" These men were relatively less likely than younger men to say that their activities would change at all under either of the hypothetical conditions. They were also relatively unconcerned with the fate of other people. They tended to "set the end at their own death—which they accepted as relatively soon—and did not care anything beyond this point. This, then, is the meaning of short time perspective" (1).

One might wonder if the apparent lack of concern for other persons and even for one's own future is necessarily associated with short time perspective *per se*. For some individuals the notion of a limited time perspective might increase the intensity and value of the remaining time because it has become that much

more precious. Perhaps Back's elderly subjects were dealing with private, isolated, *nonmodulated* futures somewhat in the way that some aged people dwell in worlds of pastness that have little communication with present or future. The implication might be that in later life one needs more than past, present, or future orientation taken separately; one needs also a skill in interweaving these realms and thus modulating each through its contact with the others. An example that comes to mind is the case of a 106-year-old magistrate who actively practices his complex and influential profession. This man apparently has a great reverence for the past, both of his profession and of local history, and a keen eye both to the present and the future. In hearing present testimony and evaluating it with historical precedents in mind, he is simultaneously making decisions for the future—here, then, is a natural interpenetration of temporal dimensions. The situation is quite different from that of the person of any age who, when he looks into his future, sees a time that is completely disconnected from past and present, and images only his own death (an image to be followed, perhaps, by a steadfast refusal to think of the future or of time in general).

H. THE INHERITANCE AND THE CHALLENGE

The adolescent bequeaths both riches and debits to that namesake who will succeed him on his traversal of the life-span. Impetus toward the future, a sense of moving into new and valuable time, and the ability to plan and imagine are among the gifts that the adolescent brings to his place on the life-span. But he leaves much unfinished business. Too often, it seems, the adolescent constructs a world-view that ignores the later stages of development. It is also likely to emphasize futurity beyond the point where this is adaptive for the mature person, and correspondingly to de-emphasize the past. The person who accepts uncritically what has been created by the adolescent within him thus finds himself rushing forward toward an imagined future that was not made for durability. If he cannot disembark from "The Future Express," he may eventually become the embittered old man who delayed or prepared too long. If his basic identity has been absorbed by the notion of perpetual youth moving toward or existing in a perpetual future, then he may become the anxious, panicky old man who can make no sense at all of a life situation that never was anticipated.

But now we must say a word for a person who has been pretty much ignored in this discussion as he has been elsewhere—surprising neglect since he exists in such large numbers. Reference is made to the person who never developed much in the way of a time orientation, who takes each day as it

comes, and is neither delighted nor depressed by the rumble of distant drums. He seems to make his way along the life-span with relatively few discontinuities. Taking life one moment or one hour at a time, he may not find things profoundly different at age 80 than they were at age 20 or age 40. He is the person we neglect when, for example, in the name of Disengagement Theory we postulate a universal and intrinsic process of aging. Many people do not gain a new appreciation of the finitude of time nor adjust their social style accordingly. They simply go on as best they can from day to day. Furthermore, there is that subgroup of "Young Prometheans" who early in their lives have surveyed what might lie before them. These people enter old age and the portals of death not completely as strangers, nor do they need to experience radical discontinuities as they move along the lifeline.

For the moment, let us concentrate upon the person who is in the tradition with which we have been chiefly concerned—the person who has always dealt with time, but never quite mastered it. His challenge is how to develop and then appropriately modify his self-identity over his entire life-span, how to make both realistic and creative use of past, present, and future. The challenge can be phrased in many ways: how to be engrossed in the present moment—the only moment we ever have—and yet retain a perspective on what has been and what will be; or how to be committed to a core of identity and values and yet be adaptive to changing times, both in society and our intrapsychic milieu.

Engrossment and perspective, dedication and flexibility—how do some people manage to accomplish this kind of integration? Perhaps when we learn enough from those who age as good wine ages we will have a place in the technical jargons of psychology for the concept of wisdom.

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DIFFERENCES IN PERCEPTION OF DESIRED JOB CHARACTERISTICS OF THE OPPOSITE SEX*¹

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A. INTRODUCTION

Herzberg, Mausner, and Snyderman (4) have suggested that job satisfaction and job dissatisfaction are caused by different job characteristics rather than by varying amounts of the same job characteristic. They refer to the job characteristics that produce satisfaction as motivators and to the job characteristics that produce dissatisfaction as hygienic factors. In general, motivators were those characteristics that satisfied the individual's need for self-actualization and self-realization in his work and revolved around the need to develop in one's occupation as a source of personal growth. Hygienes, on the other hand, tended to represent environmental factors descriptive of the job situation. This group was associated with fair treatment, supervision, wages, and working conditions. Other investigations of different respondent populations (1, 2, 3, 5, 9, 10, 11) tend to support this dual approach to job motivation.

The present research is an attempt to determine the relative importance for female and male college students of a sample of job characteristics representing both motivators and hygienic factors, and the extent to which members of one sex could predict the job-characteristic preferences of the opposite sex. Formulation of specific hypotheses was somewhat limited by lack of research in this area, but it was thought that motivators would be rated more important than hygienes for both sexes and that this dichotomy might prove useful in explaining differential accuracy of prediction.

B. METHOD

Thirty-two female and 85 male college students enrolled in an introductory industrial psychology course served as subjects. They were asked to rank order 10 job characteristics from the point of view of how important each of

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TABLE 1
MEAN RANKINGS AND RANK ORDERS OF THE 10 JOB CHARACTERISTICS

Job characteristic	Female Importance for Self		Female Importance for Opposite Sex		Male Importance for Self		Male Importance for Opposite Sex	
	Mean ranking	Rank order	Mean ranking	Rank order	Mean ranking	Rank order	Mean ranking	Rank order
Challenges Ability	2.75	1	4.38	3	3.58	2	6.79	7
Opportunities for Advancement	4.28	2	2.62	1	3.47	1	6.11	6
Good Salary	4.50	3	3.44	2	4.01	3	3.51	3
High Responsibility	5.09	4	5.78	6	5.15	4	8.32	10
Good Boss	5.31	5	6.62	7	6.28	8	3.07	1
Voice in Decisions	5.81	6	6.94	9	6.16	7	7.48	9
Job Security	6.28	7	4.72	4	5.16	5	3.86	4
Good Physical Working Conditions	6.44	8	7.94	10	6.93	9	3.22	2
Importance of the Job	6.47	9	5.69	5	5.72	6	6.84	8
Liberal Fringe Benefits	7.88	10	6.88	8	8.49	10	5.76	5

the job characteristics was to them (Importance for Self) and how important each of the job characteristics would be for a person of the opposite sex (Importance for Opposite Sex). Each subject was given enough time to complete the task to his satisfaction. The 10 job characteristics were taken from Herzberg, Mausner, and Snyderman (+) and represented five motivators and five hygies. The motivators included Challenges Ability, High Responsibility, Importance of the Job, Opportunities for Advancement, and Voice in Decisions. The hygies included Good Boss, Good Physical Working Conditions, Good Salary, Job Security, and Liberal Fringe Benefits. The 10 characteristics were placed in a random order, and each subject was given the same list.

C. RESULTS

1. *Rankings and Rank Order*

A mean importance ranking was computed for each job characteristic and a mean rank order determined for female and male Importance-for-Self and

TABLE 2
DEGREE OF AGREEMENT IN FEMALE AND MALE RANK ORDERS

Category	Degree of agreement
Female Importance for Self ($N = 32$)	.20*
Female Importance for Opposite Sex ($N = 32$)	.32*
Male Importance for Self ($N = 85$)	.27*
Male Importance for Opposite Sex ($N = 85$)	.41*

* Coefficient of Concordance, W , is significantly different from zero at the .01 level of confidence.

Importance-for-Opposite-Sex rankings. These data are presented in Table 1. Measures of the degree of agreement within a rank order are shown in Table 2. Although only moderately high, all four coefficients are significantly different from zero and suggest that, within a rank order, most individuals were applying essentially the same standard in ranking the 10 job characteristics under study. Consistent with other research (7, 8), it appears that perception of others is more consistent and a more reliable index of stereotypy than perception of self. For females as well as for males, rankings for opposite sex are more consistent than rankings for self.

2. *Intercorrelation of Rank Orders*

The four rank orders were then intercorrelated to determine the extent to which females and males assigned similar importance rankings to the job characteristics and the extent to which females and males could predict the

rankings of the opposite sex. This matrix is presented in Table 3. The following questions were asked:

1. *Do females and males assign the same importance rankings to the job characteristics?* A significant positive correlation would indicate high real similarity, whereas a significant negative correlation would indicate high real dissimilarity. The data show that both females and males tended to rank the job characteristics in approximately the same order of importance ($r_s = .84$), indicating a high degree of real similarity of job-characteristic preferences.

TABLE 3
INTERCORRELATIONS^a AMONG FEMALE AND MALE IMPORTANCE-FOR-SELF AND IMPORTANCE-FOR-OPPOSITE-SEX RANK ORDERS

Category	Female Importance for Opposite Sex	Male Importance for Self	Male Importance for Opposite Sex
Female Importance for Self	.66**	.84*	— .12
Female Importance for Opposite Sex		.89*	— .07
Male Importance for Self			— .32

^a $N = 10$ for all correlations.

* Correlation is significantly different from zero at the .01 level of confidence.

** Correlation is significantly different from zero at the .05 level of confidence.

2. *Do females and males perceive this real similarity?* Female Importance-for-Self and female Importance-for-Opposite-Sex rank orders correlated .66, indicating a fair degree of warranted assumed similarity. Females correctly predicted that males would prefer the same job characteristics as females. Male Importance-for-Self and male Importance-for-Opposite-Sex rank orders correlated —.32, indicating unwarranted assumed dissimilarity. Males tended to predict that females would prefer job characteristics different from those males themselves preferred, whereas females actually had much the same preferences as males.

3. *Can females and males predict opposite-sex job-characteristic preferences?* Female Importance-for-Opposite-Sex and male Importance-for-Self rank orders correlated .89, indicating high accuracy of prediction. Male Importance-for-Opposite-Sex and female Importance-for-Self rank orders correlated —.12, indicating low accuracy of prediction.

3. Comparisons

A comparison of female Importance-for-Self and Importance-for-Opposite-Sex rankings, and male Importance-for-Self and Importance-for-Opposite-Sex rankings, was then made for each of the 10 job characteristics. Each comparison

fell into one of three categories: (a) equally important for self and opposite sex, (b) more important for self than for opposite sex, and (c) more important for opposite sex than for self. Females ranked 18.1 per cent, 39.4 per cent, and 42.5 per cent of 320 comparisons, and males ranked 11.2 per cent, 43.3 per cent, and 45.5 per cent of 850 comparisons into these three categories. This suggests that, for the 10 job characteristics as a group, females did not display any systematic tendency toward using certain categories more often than males. Each female and male could also be seen as favoring one of these three categories, depending on where the majority of an individual's 10 comparisons fell. Table 4 presents the number and percentage of females and

TABLE 4
NUMBER AND PER CENT OF FEMALES AND MALES RANKING A MAJORITY OF THE 10
JOB CHARACTERISTICS INTO ONE OF THREE POSSIBLE IMPORTANCE CATEGORIES

Category	Females		Males	
	N	%	N	%
Equally important for self and opposite sex	11	34.4	25	29.4
More important for self than opposite sex	9	28.1	27	31.8
More important for opposite sex than self	12	37.5	33	38.8
	32		85	

males placing a majority of their 10 comparisons into one of these three categories. No sex difference in the use of a given category is evident.

4. *Motivators vs. Hygienes*

The next analysis was performed to determine whether there was any tendency for females and males to rank motivators more important than hygienes. The number of times that each motivator was ranked more important than each hygiene was determined for each subject. Females ranked motivators more important than hygienes in 62.4 per cent of 800 paired comparisons and males ranked motivators more important than hygienes in 63.5 per cent of 2125 paired comparisons. The similarity of rankings of females and males is particularly striking. Females predicted that males would rank motivators more important than hygienes in 58.2 per cent of 800 paired comparisons, and this was very close to the actual male rankings. Males, however, predicted that females would prefer motivators in only 17.9 per cent of 2125 paired comparisons, and this was significantly lower than the actual female rankings.

Similar results are obtained when one considers the number of individuals preferring motivators. An individual who ranked motivators more important than hygienes 13 or more times out of the 25 possible paired comparisons

was considered to prefer motivators. If the number of individuals preferring motivators was equal to the number of individuals preferring hygienes, the percentage of individuals preferring motivators would be 50, and *vice versa*—therefore, the greater the deviation from 50 per cent, the larger the number of individuals preferring one type of job characteristic and the fewer preferring the other type.

Table 5 presents the number and percentage of females and males preferring motivators to hygienes. A statistically significant percentage of females and males preferred motivators (Columns 1 and 3) and these percentages are very similar (71.9 and 74.1, respectively). In addition, the percentage of

TABLE 5
NUMBER AND PER CENT OF FEMALES AND MALES PREFERRED MOTIVATORS TO HYGIENES

Category	Females (N = 32)		Males (N = 85)	
	N	%	N	%
Importance for Self	23	71.9**	63	74.1*
Importance for Opposite Sex	20	62.5	8	9.4 ^a

* Critical Ratio test is significantly different from .50 at the .01 level of confidence.

** Critical Ratio test is significantly different from .50 at the .07 level of confidence.

^a Percentage difference is significant at the .01 level of confidence.

females predicting that males would prefer motivators was very similar to the actual percentage of males preferring motivators (62.5 and 71.9, respectively). On the other hand, males rarely predicted that females would prefer motivators, and their predicted percentage was significantly lower than the actual percentage of females preferring motivators (9.4 and 71.9, respectively). Thus both females and males generally rated motivators more important than hygienes for Importance for Self. Females correctly predicted that males would prefer motivators, whereas males incorrectly predicted that females would prefer hygienes.

A finer subdivision of the data presented in Table 4 introducing the motivator-hygiene distinction is provided in Table 6. Table 4 indicated no sex difference in use of the three importance categories for the 10 job characteristics as a group. Columns 1 and 2 of Table 6 show the number and percentage of females ranking a majority of motivators and hygienes into these categories. No differences appear in the two distributions. The corresponding data for males are presented in Columns 3 and 4 and reveal a different pattern. Here, significantly more males ranked motivators more important for self than for opposite sex, and significantly more males ranked hygienes more important for opposite sex than for self.

D. DISCUSSION

The female and male subjects in this investigation showed surprising agreement in their rankings of the importance of the 10 job characteristics. Only one characteristic appeared in the top five choices for females that was not in the top five choices for males, and this characteristic was in the fifth position for females. (Good Boss was fifth for females and eight for males, while Job Security was fifth for males and seventh for females.) Both females

TABLE 6
NUMBER AND PER CENT OF FEMALES AND MALES RANKING A MAJORITY OF MOTIVATORS
AND HYGIENES INTO ONE OF THREE POSSIBLE IMPORTANCE CATEGORIES

Category	Females				Males			
	Motivators		Hygienes		Motivators		Hygienes	
	N	%	N	%	N	%	N	%
Equally important for self and opposite sex	12	37.5	14	43.8	11	12.9	10	11.8
More important for self than opposite sex	12	37.5	7	21.9	71	83.5*	5	5.9*
More important for opposite sex than self	8	25.0	11	34.3	3	3.5*	70	82.4*
	32		32		85		85	

* Percentage difference for male motivators and male hygienes is significant at the .01 level of confidence.

and males valued jobs demanding and offering opportunities for use of their skills, promotion based on individual merit, accountability for one's conduct and obligations, and wages commensurate with merit and skill. The greater importance of Good Boss for females as compared with males probably stems from greater female interest in congenial social and interpersonal relationships. The greater importance of Job Security for males as compared with females may be due to the centrality of work throughout a male's lifetime.

In general, females and males tended to rank motivators more important than hygienes. Both placed four of the five motivators among their six most important characteristics. It is possible that motivators were ranked important because the respondents were young college students preparing for careers in which they could realistically anticipate chances for advancement, growth in skill, authority, and high responsibility. It has been reported (10) that the same respondents who indicated motivators as sources of job satisfaction in their middle age (30-55) indicated hygienes as the important factors for job

satisfaction in their preretirement years. Generalization of these findings to groups of different and specific characteristics should be done with caution. Respondents who are older, have more work experience, or belong to different occupational levels might well indicate different job characteristics as important for satisfaction and dissatisfaction.

Although both sexes expressed similar job-characteristic preferences, only the females were able to predict the actual preferences of the opposite sex accurately. Male inaccuracy consisted of gross overestimation of the importance of hygies and gross underestimation of the importance of motivators. Interestingly, this represented a reversal as far as their own self-importance rankings were concerned. Males emphasized job characteristics suggesting a comfortable work context (fringe benefits, physical working conditions, money, friendly boss) in their predictions of female job-characteristic preferences. Females, however, felt that characteristics leading to self-actualization and creative expression were most important.

A recent study (6) provides one framework in which to approach the findings of this investigation. MacBreyer explored differences in perception of the opposite sex by female and male college students using sentence-completion items. She found that college females perceived males more favorably than college males perceived females. She attributed this phenomenon to an androcentric bias or theory of feminine inferiority held by males. A correspondence between her conclusions and the data presented here occurs if motivators are taken to represent something more favorable or desirable than hygies. This assumption seems tenable, since both females and males ranked motivators more important than hygies for themselves. The very nature of the motivators also suggests something towards which a population of this kind should strive. The general inability of males to predict actual female job-characteristic preferences, and the systematic tendency of males to overestimate the importance of hygies at the expense of motivators in their predictions, would be attributed to the assignment of relatively unfavorable job characteristics to females. The fact that the greatest degree of agreement within a rank order is in the male prediction of female preferences is taken as further support for a male stereotype.

E. SUMMARY

Thirty-two female and 85 male college students enrolled in an introductory industrial psychology course were asked to rank order 10 job characteristics from the point of view of how important each of the job characteristics was

to them and how important each of the job characteristics would be for a person of the opposite sex. The 10 job characteristics represented five motivators and five hygiesnes, following the distinction proposed by Herzberg, Mausner, and Snyderman (4).

The following results were obtained:

1. Rank orders for female and male self-importance correlated .84, indicating high real similarity of job-characteristic preferences. Both females and males tended to rank motivators more important than hygiesnes.
2. Females correctly predicted that males had similar preferences and were able to predict the actual male rankings accurately.
3. Males incorrectly predicted that females had different preferences and were unable to predict the actual female rankings accurately.
4. Females correctly predicted that males would rank motivators more important than hygiesnes, consistent with their own self-rankings. Males, on the other hand, incorrectly predicted that females would rank hygiesnes more important than motivators, a reversal as far as their own self-importance rankings were concerned. The greatest within-rank-order consistency was in the male predictions of the female job-characteristic preferences.
5. The general male inaccuracy and the more specific tendency to overestimate the importance of hygiesnes at the expense of the motivators in their prediction of female preferences is attributed to a stereotype of feminine inferiority held by males.

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DIFFERENCES IN PERCEPTION OF DESIRED JOB CHARACTERISTICS OF THE SAME SEX AND THE OPPOSITE SEX*¹

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A. INTRODUCTION

A theoretical framework suggesting a dual approach to job motivation has resulted from a series of investigations prompted by the initial results of research of Herzberg, Mausner, and Snyderman (2). These investigations indicate that certain job characteristics are important for and lead to job satisfaction (but not to job dissatisfaction), while other job characteristics are important for and lead to job dissatisfaction (but not to job satisfaction). These authors (2) referred to the characteristics that produce satisfaction as motivators and to the characteristics that produce dissatisfaction as hygies. In general, motivators were those characteristics that satisfied the individual's need for self-actualization and self-realization in his work. These revolved around the need to develop in one's occupation as a source of personal growth. Hygies, on the other hand, tended to represent environmental factors descriptive of the job context. This group was associated with fair treatment in supervision, wages, and working conditions.

Burke (1) had female and male college students rank 10 job characteristics (five motivators and five hygies) in order of Importance for Self, and Importance for Opposite Sex. The results indicated that both sexes had similar job-characteristic preferences. Furthermore, both sexes ranked motivators more important for themselves than hygies. Females correctly assumed that males had preferences similar to their own and were able to predict the actual male preferences accurately. Males, however, incorrectly assumed that females had preferences different from their own. Consequently, they were unable to predict the actual female preferences accurately. Male inaccuracy consisted of gross overestimation of the importance of hygies and gross underestimation of the importance of motivators. This tendency interestingly represented a reversal of their own self-importance rankings. This phenomenon was at-

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tributed to an "androcentric bias" or stereotype of feminine inferiority held by males.

The present study was designed to replicate and elaborate Burke's investigation (1) by having females and males predict same-sex rankings of the 10 job characteristics, in addition to Importance-for-Self and Importance-for-Opposite-Sex rankings.

B. METHOD

Sixteen female and 54 male college students enrolled in an introductory industrial psychology course served as subjects. They were asked to rank 10 job characteristics in order of Importance for Self and for members of the same sex and the opposite sex. Each subject was given enough time to complete the task to his satisfaction. The 10 job characteristics were taken from Herzberg, Mausner, and Snyderman (2) and represented five motivators and five hygienic factors. The motivators included Challenges Ability, High Responsibility, Voice in Decisions, Importance of the Job, and Opportunities for Advancement. The hygienics included Good Boss, Good Physical Working Conditions, Good Salary, Job Security, and Liberal Fringe Benefits. The 10 characteristics were placed in a random order and each subject was given the same list.

C. RESULTS

1. *Rankings and Rank Order*

A mean importance ranking was computed for each job characteristic and a mean rank order determined for female and male Importance-for-Self, Importance-for-Same-Sex, and Importance-for-Opposite-Sex rankings. These data are presented in Table 1. Measures of the degree of agreement within a rank order are given in the last row of this table. Although only moderately high, all six coefficients are significantly different from zero and suggest that, within a rank order, most individuals were applying essentially the same standard in ranking the 10 job characteristics under study. Consistent with the earlier study (1) and other published research (6, 7), it appears that perception of other's responses is more consistent and a more reliable index of stereotypy than perception of self.

2. *Intercorrelation of Rank Orders*

The six rank orders were then intercorrelated to determine the extent to which females and males assigned similar importance rankings to the job characteristics and the extent to which they were able to predict the rankings

TABLE 1
MEAN RANKINGS AND RANK ORDERS OF THE 10 JOB CHARACTERISTICS

Job characteristic	Females						Males					
	Importance for Self		Importance for Same Sex		Importance for Opposite Sex		Importance for Self		Importance for Same Sex		Importance for Opposite Sex	
	Mean rank	Rank order	Mean rank	Rank order	Mean rank	Rank order	Mean rank	Rank order	Mean rank	Rank order	Mean rank	Rank order
Challenges ability	2.50	1	4.50	3	3.81	3	3.91	3	4.89	4	6.41	7
Good salary	3.38	2	2.56	1	2.50	1	3.76	2	2.76	1	3.85	4
Opportunities for advancement	3.94	3	6.00	6	3.12	2	3.56	1	4.13	3	5.98	6
Good boss	5.12	4	4.94	5	7.12	8	6.59	8	6.02	5	3.67	2
Importance of the job	5.75	5	6.62	7	5.56	5	5.20	4	6.42	6	7.09	9
Job security	5.88	6	4.62	4	3.94	4	5.56	5	3.78	2	3.76	3
High responsibility	6.19	7	7.81	9	5.94	6	5.85	6	6.94	10	8.22	10
Voice in decisions	6.81	8	8.06	10	7.31	9	5.91	7	6.91	9	6.96	8
Good physical working conditions	7.12	9	4.06	2	8.62	10	7.02	9	6.67	8	3.15	1
Liberal fringe benefits	8.31	10	6.81	8	7.06	7	7.65	10	6.48	7	5.80	5
Coefficient of concordance, <i>W</i>	.36		.37		.47		.22		.25		.32	

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of same and opposite sex. This matrix is presented in Table 2. The following general questions were asked:

1. *Do females and males assign the same importance rankings to the job characteristics?* A significant positive correlation would indicate high real similarity, whereas a significant negative correlation would indicate high real dissimilarity. The data show that both females and males tended to rank the job characteristics in approximately the same order of importance ($r_s = .83$), indicating a high degree of real similarity in job-characteristic preferences.

TABLE 2
INTERCORRELATIONS^a AMONG FEMALE AND MALE IMPORTANCE-FOR-SELF, IMPORTANCE-FOR-SAME-SEX, AND IMPORTANCE-FOR-OPPOSITE-SEX RANK ORDERS

Category	Female Importance for Same Sex	Female Importance for Opposite Sex	Male Importance for Self	Male Importance for Same Sex	Male Importance for Opposite Sex
Female Importance for Self	.49	.77*	.83*	.77*	— .07
Female Importance for Same Sex		.39	.30	.67**	.67**
Female Importance for Opposite Sex			.89*	.78*	— .19
Male Importance for Self				.65**	— .31
Male Importance for Same Sex					.39

^a $N = 10$ for all correlations.

* Correlation is significantly different from zero at the .01 level of confidence.

** Correlation is significantly different from zero at the .05 level of confidence.

2. *Do females and males perceive this real similarity?* Female Importance-for-Self and female Importance-for-Opposite-Sex rank orders correlated .77, indicating a high degree of warranted assumed similarity. Females correctly assumed that males would prefer the same job characteristics as females. Male Importance-for-Self and male Importance-for-Opposite-Sex rank orders correlated —.31, indicating some unwarranted assumed dissimilarity. Males assumed that females would prefer job characteristics different from those preferred by males.

3. *Can females and males predict same-sex job-characteristic preferences?* Female Importance-for-Self and Importance-for-Same-Sex rank orders correlated .49, indicating low accuracy of prediction. Male Importance-for-Self and Importance-for-Same-Sex rank orders correlated .65, suggesting only moderate accuracy of prediction.

4. *Can females and males predict opposite-sex job-characteristic preferences?* Female Importance-for-Opposite-Sex and male Importance-for-Self rank orders correlated .89, indicating high accuracy of prediction. Male Importance-for-Opposite-Sex and female Importance-for-Self rank orders correlated $-.07$, indicating low accuracy of prediction.

3. *Relative Importance of Motivators vs. Hygienes*

The next analysis was made to determine whether there was any tendency for females and males to rank motivators generally more important than hygienes. The number of motivators ranked more important than each hygiene in 25 possible paired comparisons was computed for each subject. If

TABLE 3
MEAN NUMBER OF MOTIVATORS RANKED ABOVE EACH HYGIENE

Category	Females		Males	
	Mean	SD	Mean	SD
Importance for Self	14.9 ^b	4.56	15.6 ^a	5.98
Importance for Same Sex	7.0 ^a	5.88	11.2	6.02
Importance for Opposite Sex	14.2 ^c	3.89	5.2 ^a	6.45

^a *t* value for difference between obtained mean and expected value of 12.5 is significant at less than the .01 level of confidence.

^b *t* value for difference between obtained mean and expected value of 12.5 is significant at less than the .05 level of confidence.

^c *t* value for difference between obtained mean and expected value of 12.5 is significant at less than the .10 level of confidence.

the number of motivators ranked more important than each hygiene equalled the number of hygienes ranked more important than each motivator, the number of motivators ranked more important than each hygiene would be 12.5 on the average, and *vice versa*: thus the greater the deviation from 12.5, the more important one type of job characteristic and the less important the other type. The mean number of motivators ranked above each hygiene in each of the six rank orders is presented in Table 3.

Both females and males ranked a significant number of motivators more important than hygienes for self ($p < .05$ and $p < .01$, respectively). Both females and males ranked a greater number of hygienes more important than motivators in their predictions of same-sex preferences ($p < .01$ and p approaching .10, respectively). The sexes differed, however, in their predictions of opposite-sex preferences. Females tended to rank a greater number of motivators more important than hygienes ($p < .10$), whereas males ranked a greater number of hygienes more important than motivators ($p < .01$).

4. *Predictions of Same-Sex and Opposite-Sex Preferences*

Females incorrectly predicted that members of the same sex would rank hygienes more important than motivators and their prediction was significantly different from the actual female preferences ($t = 4.24, p < .001$). Males incorrectly predicted that members of the same sex would rank hygienes more important than motivators and their prediction was significantly different from the actual male preferences ($t = 3.78, p < .001$). Both sexes were unable to predict the relative importance of motivators and hygienes for members of the same sex. In addition, their predictions represented a reversal of their own preferences.

Females correctly predicted that members of the opposite sex would rank motivators more important than hygienes and their prediction was very close to the actual male preferences. Males, on the other hand, incorrectly predicted that members of the opposite sex would prefer hygienes to motivators and their prediction was significantly different from the actual female preferences ($t = 5.58, p < .001$).

5. *Errors in Prediction*

Comparison of an individual's Importance-for-Self ranking of a given job characteristic and his Importance-for-Same-Sex ranking (or his Importance-for-Opposite-Sex ranking) of that same characteristic indicates the relative importance of that characteristic for self and same sex (or opposite sex). Each of these comparisons necessarily falls into one of three categories: (a) equally important for both, (b) more important for self, or (c) less important for self. Each individual can then be considered to favor one of these categories depending on where the majority of his comparisons fall. This can be carried out for the five motivators and the five hygienes separately.

The top half of Table 4 presents the number and percentage of females and males having a majority of self- and same-sex comparisons in each of the three categories. Both sexes systematically ranked motivators more important for self than same sex, and hygienes less important for self than same sex ($p < .001$).

Corresponding data for female and male self- and opposite-sex comparisons are presented in the bottom half of Table 4. Females favored the three importance categories about equally for both motivators and hygienes. Males, however, systematically ranked motivators more important for self than opposite sex and hygienes less important for self than opposite sex ($p < .001$). When errors in prediction were made, they consisted of overestimating the importance of hygienes and underestimating the importance of motivators.

TABLE 4
 NUMBER AND PERCENTAGE OF FEMALES AND MALES RANKING A MAJORITY OF SELF- AND SAME-SEX COMPARISONS AND SELF- AND
 OPPOSITE-SEX COMPARISONS INTO EACH OF THE IMPORTANCE CATEGORIES
 (Introducing the Motivator-Hygiene distinction)

Category	Females				Males			
	Motivators		Hygienes		Motivators		Hygienes	
	N	%	N	%	N	%	N	%
Equally important for self and same sex	3	18.8	3	18.8	23	42.6	25	46.3
More important for self than same sex	13	81.2	0	0.0	27	50.0	3	5.6
Less important for self than same sex	0	0.0	13	81.2	4	7.4	26	48.2
	Chi square = 26, $p < .001$ with 2 <i>df</i> .				Chi square = 35.42, $p < .001$ with 2 <i>df</i> .			
Equally important for self and opposite sex	8	50.0	10	62.5	9	16.7	11	20.4
More important for self than opposite sex	4	25.0	3	18.8	43	79.6	2	3.7
Less important for self than opposite sex	4	25.0	3	18.8	2	3.7	41	75.9
	Chi square is not significant.				Chi square = 72.93, $p < .001$ with 2 <i>df</i> .			

D. DISCUSSION

Consistent with the earlier study (1), females and males showed surprising agreement in their rankings and in their preference for motivators. This may have resulted because the respondents were young college students preparing for careers in which they could realistically anticipate chances for advancement, growth in skills, high responsibility, and other motivators. Saleh (8) observed that the same respondents who indicated motivators as sources of job satisfaction in their middle age (30-55) indicated hygienes as important sources of job satisfaction in their preretirement years (60-65).

Maslow (4, 5) has suggested a hierarchy into which needs arrange themselves in order of importance. The most basic motivators are the elementary biological needs. When these needs have been fulfilled, there is a tendency to become increasingly concerned with preserving this good fortune and newly gained *security*. At a more advanced level, an individual may begin to hunger for some luxuries, later for some status, and still later for achievement for its own sake. The motivators and hygienes used in this investigation represent higher-order and lower-order needs, respectively.

When errors in prediction were made, they consisted of overestimating the importance of hygienes (lower-order needs) and underestimating the importance of motivators (higher-order needs). This may be due to a male stereotype of feminine inferiority (1, 3), resulting in the males' inability to predict female preferences accurately. But since both sexes also used a stereotype of inferiority in predicting the job-characteristic preferences for members of the same sex, it appeared that something more than a male stereotype of females was operating.

The latter finding adds support for a single explanation based on the notion of defensive comparisons. When the ego is threatened, it is motivated to reduce the threat. This can be done in a number of ways, one of which is through the mechanism of defensive comparison. By confirming that the other possesses undesirable qualities, is worse off, or is inferior, the ego can reinterpret the other that was initially threatening the self-concept so as to reduce the threat.

The current influx of females into traditionally male endeavors is probably heightening the pressures for success that males experience. The threat posed by females in academic and professional occupations is a real one. This increased threat can be minimized, according to the defensive-comparison principle, if females are seen as incapable of wanting the same things as males, or as not wanting the same things as males. This would account for the male

stereotype of opposite-sex preferences. Since females do not experience a corresponding threat from males (males are not after a traditionally female prerogative), they would not use a defensive comparison here. Both females and males, however, would find members of the same sex threatening. This must occur because members of the same sex must compete with self for the myriad of objects that are related to a given sex role. This would account for both the female and male stereotypes of same-sex preferences. In all cases the stereotype reduces the threat of the other because the other appears less favorable than the self.

E. SUMMARY

Sixteen female and 54 male college students enrolled in an introductory industrial psychology course ranked 10 job characteristics in order of Importance for Self, Importance for Same Sex, and Importance for Opposite Sex. The 10 job characteristics were taken from Herzberg, Mausner, and Snyderman (2) and represented five motivators and five hygiesnes.

The following results were obtained:

1. Rank orders of female and male self-importance correlated .83, indicating high real similarity. Both sexes also ranked motivators more important in general than hygiesnes.
2. Both sexes were unable to predict the preferences of members of the same sex accurately.
3. Both sexes incorrectly predicted that members of the same sex would rank hygiesnes more important than motivators.
4. Females correctly predicted opposite-sex importance rankings and assigned greater importance to the motivators than to the hygiesnes in their predictions.
5. Males, on the other hand, were unable to predict the rankings of the opposite sex. They predicted that females in general would rank hygiesnes more important than motivators.
6. In all cases, errors consisted of overestimating the importance of the actually less important characteristic at the expense of the more important characteristic. An explanation for this phenomenon in terms of defensive comparisons is proposed.

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SOME METHODOLOGICAL CONSIDERATIONS IN
PHYSIOLOGICAL RESEARCH ON
AVERSIVE BEHAVIOR*¹

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A. INTRODUCTION

The general problem of exploring the responses of subhuman organisms to noxious stimulation has been approached from several viewpoints. At a behavioral level of analysis, investigators have been concerned with unlearned response patterns to electric shocks of varying intensities (5, 18, 32, 35), with determinations of shock-intensity aversion thresholds using adaptations of psychophysical methods (2), and with the aftereffects of variations in shock intensity on acquisition of instrumental responses (7, 8, 11). At a neurophysiological level of description, there have been several attempts to record changes in electroencephalographic responses by means of chronically implanted electrodes from various cortical and subcortical structures in freely moving preparations during prolonged noxious stimulations (12, 13, 14, 20), as well as studies of limbic system lesion and stimulation effects on aversive behavior (1, 6, 26, 38, 39, 43). Responses of single neurons to noxious stimulation of the sciatic nerve, paw, and other skin areas have been recorded from such structures as the amygdala (23), ventrobasal thalamus (29), somatosensory cortex (29, 33, 40), and motor cortex (21) in acute anesthetized preparations. Potential changes have also been recorded from the cerebellum and cortex after stimulation of cutaneous (sural) nerve (30), and from the amygdala after stimulation of the vagus nerve (15).

B. REVIEW OF EXISTING STUDIES

This paper will use information from each descriptive level in order to develop testable hypotheses that would clarify the processes involved in responses to very intense, just-subtetanizing noxious stimulation (UCS). The arguments to be presented are:

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1. Analysis of shock effects into two components—a primary drive of “pain” and an acquired drive of “fear” (27), resulting in running and crouching behavior, respectively—does not adequately represent the spectrum of unconditioned responses observed in organisms subjected to shock; in particular, unconditioned responses to intense just-subtetanizing shock are unique reactions that differ qualitatively from responses to milder shocks.

2. Procedures employing indirect measures reflect, to some extent, the disruptive effects of intense shocks. Acquisition of aversive responses may be influenced to a greater degree by unconditioned stimulus (UCS) intensity aftereffects (i.e., traces) than acquisition with procedures employing milder shocks (16).

3. Relatively long term changes in the firing patterns of neural units in cortical and subcortical areas, and temporary, reversible changes in the neurosecretory cells of the pituitary (34), may serve as the basis for responses to traces of intense noxious stimulation reported by Carlson (4), Goldstein (10), and Solomon and Wynne (37).

1. *First Point*

Several studies support the first point, that unconditioned responses to intense shock (UCS) include a variety of autonomic and motor responses. Cannon (3) has described peripheral, sympathetic, changes elicited by “fright” that include increased sweating, cardiac acceleration, elevation of blood sugar level, deep respiration, urination, and defecation. Many of these reactions have been used as indicators of emotionality in conditioning studies, but the quantitative relationships among levels of noxious stimulation, autonomic function, and behavioral indices of conditioning are not at all clear (4, 19, 25). Delgado (5) has reported “pain-like responses” in monkeys, characterized by facial grimaces, vocalizations, escape movements, increased heart rate and respiratory rate, urination, and defecation, evoked by stimulation of such areas as the posteroventral nucleus of the thalamus, the crus of the fornix, and the posterior hippocampus. Kimble (18) has identified “flinch,” “jump,” and “crouch” components of the response pattern to electric shock in rats, that vary in frequency of occurrence with shock intensity; the highest shock level elicited a large proportion of “jump” responses, but this level (.9 ma.) was considerably below intensities that are just-subtetanizing for rats (3-4 ma.). Roberts (32) has described three behavior patterns in cats—“flight,” “shock-pain,” and “alarm”—that vary with intensity of hypothalamic stimulation. Warner (41, 42) has provided detailed descriptions of a variety of unconditioned responses to shock exhibited by rats, but these protocols do not permit

systematic analysis of the response patterns. It is obvious that the gross motor-response patterns exhibited by organisms during intense noxious stimulation need further systematic investigation, and that these complex behaviors cannot be adequately described in terms of simple "pain" or "fear" processes.

2. *Second Point*

The second point—i.e., that some conditioning procedures reflect the disruptive effects of intense shocks—receives support from recent behavioral studies of the development of "fear" in unrestrained, subhuman organisms [e.g., Carlson (4); Goldstein (10); and Kalish (16)]. These procedures consist of two phases: (a) a "classical" acquisition session, during which a neutral conditioned stimulus (CS) is paired with an aversive UCS of *fixed duration*, and (b) an "instrumental" test session that measures the effect of CS presentation in the absence of shock. Responses (R_1) elicited by the aversive UCS *are not recorded* during the conditioning session; strength of acquired "fear" is, instead, inferred from strength of a hurdle jump response (R_2) that is motivated by CS onset and reinforced by CS termination during the test session. It is generally assumed that there is a direct relationship between strength of R_2 and strength of "fear."

Kalish (16) demonstrated orderly, curvilinear relationships between number of CS-UCS pairings and strength of R_2 at a relatively mild shock (UCS) level. It has been found, however, that when shock intensity is varied within a wide range that includes a high, just-subtetanizing value at the upper limit, the group of functions relating number of CS-UCS pairings to the test response varies with level of hurdle jump performance (R_2) and with UCS intensity; performance increases at a faster rate and exhibits greater resistance to extinction after conditioning with an intense shock (UCS) than after conditioning with a low shock (4, 10). Such interactions among UCS intensity, number of CS-UCS pairings, and hurdle-jump performances (R_2) have been described in terms of the extinction during the test session of hypothetical competing responses (R_1) that transfer from the conditioning session (10).

Several studies support the assumption that a variety of motor responses (R_1) can become conditioned to CS during the "classical" acquisition session and that they undergo differential extinction during the "instrumental" test session. Trials on which UCS is omitted, during a classical session, are followed on the next trial by conditioned responses (R_1) of diminished strength (36). Kellogg (17) has described the appearance of "superstitious" behavior during leg-flexion conditioning of dogs, consisting of movements of any or all

of the four limbs, head movements, trunk and tail movements, and postural adjustments. This irrelevant motor behavior (R_1) persisted during conditioning and "sometimes (reached) . . . a kind of stable level which . . . (was) maintained indefinitely. The behavior contained as an essential and final component the response of the shocked member itself" (17, p. 173).

Comparison of experiments by Goldstein (10), Kalish (16), Kellogg (17), Kimble (18), McAllister and McAllister (24), and Sheffield (36) suggests a theoretical model for response selection mechanisms operating during successive phases of aversive conditioning that may be of some value in generating testable hypotheses.

a. Phase A. Initial pairing of a neutral CS with an aversive UCS elicits a large number of conditioned and unconditioned responses (R_1) that are unorganized and are distributed randomly with respect to response modality, direction, and strength. The morphology, number, and strength of R_1 responses vary with such factors as CS intensity, UCS intensity and duration, and type of shock source employed (e.g., constant current, constant voltage, or matched impedance) (2).

b. Phase B. Subsequent pairings of CS and UCS tend to elicit smaller samples of R_1 responses than are elicited in Phase A. The morphology, strength, and direction of certain R_1 components (e.g., crouching, jumping, running, grooming, shivering, defecation, urination) become increasingly well defined and vary with such factors as number of CS-UCS pairings and intensity of UCS.

c. Phase C. Presentation of CS alone elicits R_1 response components that include the indicator, or test, response (R_2). Strength of R_2 varies with such factors as UCS intensity aftereffects (i.e., traces), number of CS-UCS pairings, time between Phases B and C, and similarity between stimulus elements of Phases B and C.

d. Phase D. Presentation of CS alone elicits R_2 and few, if any, R_1 responses. Strength of R_2 varies with such factors as number and distribution of test trials and UCS intensity aftereffects.

The most significant variables affecting strength of R_2 , therefore, include (a) proportion of trials on which CS is paired with UCS, (b) duration of UCS, (c) intensity of UCS, (d) degree of similarity among stimulus elements of the successive phases, and (e) degree of similarity between R_1 and R_2 response components.

3. Third Point

The third point—i.e., that immediate and persisting changes in neural firing patterns and temporary, reversible, changes in pituitary function may serve as

the physiological basis of aversive conditioning—is highly speculative, but receives some support from a number of recent investigations of the neurophysiological basis of “pain,” and “fear.” The model of aversive conditioning may be employed to demonstrate that studies that correlate subcortical structure with behavioral measures of shock effects have investigated only a limited sample of the events that occur during the phases of aversive conditioning. Thomas (38) has argued that a number of test procedures ought to be used in analysis of limbic system function, but the majority of experiments available have employed only variations of Estes and Skinner’s (9) conditioned suppression technique (CER) or Mowrer and Lamoreaux’s (31) shuttle-box avoidance procedure (CAR) as measures of conditioned emotional responses and conditioned avoidance responses (1, 26, 39, 43). It is questionable, however, whether use of only CER and CAR techniques—without exploring the differences between these methods and simpler ones, such as the acquired drive method (16), and without evaluating complexities introduced by the test procedures—will contribute adequate information concerning neural mechanisms in pain, fear, or emotion. Miller (28), for example, has argued that more direct measures of the development of “fear” are necessary and has suggested that peripheral indicators such as heart rate changes and GSR responses do not adequately reflect immediate changes in response to noxious stimulation. It may, therefore, be necessary to develop techniques that sample the response mechanisms during each of the four phases of aversive conditioning.

There is some evidence concerning the neural structures involved in responses to strong noxious stimulation. McCleary (26), for example, found that lesions placed in subcallosal cortex and cingulate gyrus of cats produced differential effects on the aversive components (CER) of an approach-avoidance conflict and of a shuttle-box avoidance task (CAR). Subcallosal lesions eliminated the aversive components of the conflict situation but had no influence on acquisition of the shuttle-box avoidance response. [Septal lesions in rats had a similar effect on conflict (38).] Weiskrantz (43) has shown that amygdalectomized monkeys exhibit lower levels of CAR and CER response than animals with lesions of the inferotemporal cortex or sham operate controls, and these responses extinguish rapidly. There were no differences, however, between lesion effects on CAR and on CER response. Brady, Schreiner, Geller, and Kling (1) demonstrated that amygdalectomized cats require more trials to learn a CAR than animals with lesions in the hippocampus or cingulate cortex. After the CAR has been established, however, amygdalectomy has no effect on retention of the response. Thomas and Otis (39) have extended these findings by showing that, in rats, lesions of the hippocampus,

which also disrupted fibers to the cingulate cortex, retarded acquisition of the CAR.

Electroencephalographic (EEG) evidence that amygdaloid and hippocampal structures are involved in aversive conditioning has been presented by John and Killam (14), Lesse (20), and Liberson and Ellen (22). John and Killam (14) have reported that, during the course of CAR conditioning in cats, EEG responses may be recorded from visual cortex, auditory cortex, lateral geniculate, superior colliculus, amygdala, and hippocampus. Initial responses of these structures to UCS presentation drop out and, after pairing of CS and UCS, reappear in all structures except amygdala and hippocampus; upon prolonged CAR conditioning, bursts reappear in the amygdala. Liberson and Ellen (22), recording from rat hippocampus, occipital, and frontal areas during aversive conditioning, reported activity similar in frequency to the frequency of the CS but found no correlation between EEG records and performance on an individual trial of avoidance conditioning. Lesse (20) has also reported a localized change in EEG pattern recorded from amygdaloid nuclei during conditioning. The EEG studies are not directly relevant to the precise analysis of UCS intensity effects in simple aversive conditioning because these experiments have required large numbers of CAR trials, extending over relatively long periods of time, in order to obtain changes in neural response patterns. The time course of events suggested by the general model of aversive conditioning is of the order of seconds and hours rather than the days and weeks required for electroencephalographic changes to be detected using CAR training.

C. SUMMARY

This review can be summarized by outlining some of the neural events that may occur during the phases of aversive conditioning:

1. It is assumed that when an organism is subjected to an intense noxious UCS (Phase A), visual and auditory afferent pathways are temporarily blocked, but recover with time after cessation of UCS. Recovery time may vary exponentially with intensity of UCS so that, at very high shock levels, conditioning of R_1 responses may be influenced by relatively long term UCS aftereffects (30-second to three- to five-minute traces) while at low shock levels conditioning of R_1 responses may be influenced by short term UCS traces (one to 30 seconds).

2. During successive CS-UCS pairings (Phase B), there may be changes in complexity and shifts in loci of patterns of neural firing involving cortical, amygdaloid, hippocampal, and septal areas.

3. Although this suggestion is highly speculative, it is assumed that relatively long term changes in patterns of neural firing or in pituitary function, during Phases C and D, may be responsible for "partial irreversibility" of effects of intense, traumatic stimulation reported by Solomon and Wynne (37).

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THE IDEA OF IMMANENT JUSTICE AMONG LEBANESE CHILDREN AND ADULTS*¹

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A. INTRODUCTION

In his investigation of children's ideas of justice and punishment, Piaget (3) finds the idea of immanent justice to be prominent among younger children and to diminish with age. Punishment is looked upon by the young child as resulting from a wrongful act, not because of its naturalistic consequences but as a retribution from nature or from the supernatural. Nature and the supernatural act, as do adults, to constrain the child. If a child disobeys—for example, by using a knife to sharpen his pencil, which he is forbidden to do—and cuts his finger in the process, the accident does not occur because of his lack of skill in using a knife or clumsiness due to hurry and strain in performing a forbidden act (naturalistic explanation), but because he deserves punishment (immanent justice). The child explains the possibility of this kind of punishment in either or both of two ways: in the absence of the adult the knife punishes the child because it knows he is disobedient (animistic), or God sees and punishes him (supernatural).

Piaget recognizes that neither intellectual growth nor experience alone can explain the diminution of the idea of immanent justice among older children. In addition to these influences, there are affective factors due to individual and social experiences.

The investigations of Piaget (3) on normal children and Abel (1) on the feeble-minded show an inverse relationship between mental age and ideas of immanent justice. In both studies children of low mental ages show a higher frequency of the idea of immanent justice among children of the same age than do those of high mental ages. Abel's comparison of two groups of subnormals, one institutionalized and the other living in an urban community, and also her comparison of those who had been in the institution less than one year with those institutionalized over six years, equated for mental age, show that ex-

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posure to an atmosphere of intense moral realism increases the frequency of immanent justice. Thus mental development and experience both are factors related to the occurrence of immanent justice.

The present study started with the hypothesis that, in a culture like that of Lebanon, two related environmental factors would reinforce the idea of immanent justice to such an extent that its occurrence among adults of normal intelligence but of little education would not be unusual. These two related factors are religious-moral teaching and child-rearing practices. In Lebanon adults often say to a child—who undergoes an accidental unpleasant experience, such as cutting a finger or falling, following a misdeed—statements like this: "It serves you right, you deserve it," or "You see how God punished you." This kind of reasoning, however, is not limited to child behavior. In the absence of obvious misdeed, people are apt to suspect a hidden fault that invoked God's anger in the case of a neighbor who suffers a misfortune. In relation to one's own troubles, it is common to implore God's mercy, wondering at the same time what possible faults one could have committed unknowingly. This attitude among adults is encouraged by the deliberate teaching of religious leaders.

In Middle Eastern thinking another possible cause for misfortune is destiny or fate, which is independent of one's deeds, good or bad. The occurrence of this category among the responses in this study is interesting, even though it was not envisaged in the plan of the investigation.

The main purpose of this study, therefore, was to investigate the frequency of ideas of immanent justice among Lebanese children and adults in comparison with the data reported by Piaget and others. The inclusion of adults in the sample adds a new note to the study of the idea of immanent justice, as previous studies in other cultures have been concerned mainly with children.

B. SAMPLE AND PROCEDURE

Two main groups of Lebanese subjects were interviewed. Group I consisted of students 6 to 25 years of age in elementary and secondary schools and in college. Group II were adults who were out of school. Some of these were illiterates, while those with the highest education had completed high school. The age range for Group II was 18 to 45 years.

Tables 1 and 2 give certain data concerning the subjects who were tested. All subjects were interviewed individually. Elementary and secondary school subjects were given one or more of Piaget's three stories regarding immanent justice (3, pp. 250-251). Each subject was told a story in Arabic and then asked certain questions given below following the story. The younger subjects were asked to repeat the story to make sure that they understood it. The three stories follow:

Story I. Once there were two children who were stealing apples in an orchard. Suddenly a policeman came along and the two children ran away. One of them was caught. The other one, going home by a roundabout way, crossed a river on a rotten bridge and fell into the water. Now what do you think? If he had not stolen the apples and had crossed the river on that rotten bridge, would he have fallen into the water?

Story II. In a class of very little children the teacher had forbidden them to sharpen their pencils themselves. Once, when the teacher had her

TABLE 1
GROUP I—SUBJECTS IN SCHOOL

Ages	Total number	Male	Female	Moslem	Christian
<i>Elementary and secondary schools</i>					
6-8	130	60	70	54	76
9-11	144	91	53	105	39
12-14	125	57	68	74	51
15-17	37	12	25	27	10
<i>College</i>					
18-25	103	37	66	35	68
Totals	539	257	282	295	244

TABLE 2
GROUP II—SUBJECTS OUT OF SCHOOL

Ages	Total number	Male	Female	Moslem	Christian
<i>Those with some education</i>					
18-25	45	14	31	12	33
25-45	23	13	10	13	10
<i>Illiterates</i>					
18-25	57	34	23	13	44
Totals	125	61	64	38	87

back turned, a little boy took the knife and sharpened his pencil. But he cut his finger. If the teacher had permitted him to sharpen his pencil, would he have cut himself just the same?

Story III. There was a little boy who disobeyed his mother. He took the scissors one day when he had been told not to. But he put them back in their place before his mother came home, and she never noticed anything. The next day he went for a walk and crossed a stream on a little bridge. But the plank was rotten. It gave way, and in he fell with a splash. Why did he fall into the water? (And if he had not disobeyed would he have fallen in just the same?)

For subjects above age 17, both in college and outside school, it was thought better to devise a different set of stories more pertinent to adult activities. These were as follows:

Story IV. A rich businessman had a comfortable life with his family. One of his good neighbors lost his fortune and his son needed an operation. He went to his rich neighbor, the businessman, and asked for financial help to pay the expenses of his son's operation. The businessman refused the request of the neighbor selfishly for no good reason. Some time later this rich man's son had an operation and died. Why do you think this happened to the rich businessman's son? Would it have happened just the same had the father not refused the neighbor's request for help?

Story V. A man owned a healthy cow and lived on the income from

TABLE 3
RESPONSES OF SUBJECTS IN SCHOOL

Group	N	Immanent	All subjects Per cent of responses			Naturalistic
			Mixed	Destiny		
Ages 6-8						
Number of subjects	130					
Number of responses	390	72	18	—		10
Ages 9-11						
Number of subjects	144					
Number of responses	432	75	16	—		9
Ages 12-14						
Number of subjects	125					
Number of responses	375	63	20	1		16
Ages 15-17						
Number of subjects	37					
Number of responses	111	20	46	17		17
Ages 18-25						
Number of subjects	103					
Number of responses	309	14	8	7		57

the sale of the milk. To increase his profits he mixed the cow's milk with water and sold it to people without their being aware of the trick. One morning as he went to feed the cow he found her sick, and within a few hours the cow died. Why do you think the cow died? Would she have died in this manner had the owner not played the trick on the customers?

Story VI. There was a woman in a certain neighborhood who continuously spoiled the reputation of the children of other families. Any time she saw the neighbor's son come home late, for instance, she would say he was drunk, while the young man was really coming home late from his work. When her children grew up, one of her sons became a drunkard

and one of her daughters was divorced by her husband after six years of marriage. Why do you think this happened to her children? Would it have happened had she not spoiled the reputation of the neighbor's children?

C. RESULTS

Table 3 gives the responses of the school-age and college subjects. Since each subject was given three stories, the number of responses on which Table 3 is

TABLE 3 (*continued*)

Group	N	Boys Per cent of responses			
		Immanent	Mixed	Destiny	Naturalistic
Ages 6-8					
Number of subjects	60				
Number of responses	180	69	18	—	13
Ages 9-11					
Number of subjects	91				
Number of responses	273	72	16	—	12
Ages 12-14					
Number of subjects	57				
Number of responses	171	61	19	1	18
Ages 15-17					
Number of subjects	12				
Number of responses	36	14	39	25	22
Ages 18-25					
Number of subjects	37				
Number of responses	111	8	8	8	76

based is three times the number of subjects. The responses were divided into four categories according to the nature of the cause ascribed to the accident, illness, or other misfortune. The four categories are given below with explanations and examples:

1. *Immanent*. This category refers to trouble viewed as punishment. Example: The little boy cut his finger because he did wrong; he would not have cut it if he had had the teacher's permission. The rich man's son died because the father refused to help the neighbor in similar trouble; the son would not have died if the rich man had helped the neighbor.

2. *Mixed (Immanent and Naturalistic)*. This refers to responses in which trouble is connected with misdeed and at the same time the natural reason of the event recognized. Example: The son of the rich businessman died because the father refused to help the neighbor. Would he have died if the father had not refused to help? "Yes."

3. *Destiny*. This category contains responses in which fate and not the

TABLE 3 (continued)

Group	N	Immanent	Girls Per cent of responses			Naturalistic
			Mixed	Destiny		
Ages 6-8						
Number of subjects	70					
Number of responses	210	76	16	—		7
Ages 9-11						
Number of subjects	53					
Number of responses	159	81	14	—		5
Ages 12-14						
Number of subjects	68					
Number of responses	204	62	19	1		15
Ages 15-17						
Number of subjects	25					
Number of responses	75	23	49	13		15
Ages 18-25						
Number of subjects	66					
Number of responses	198	18	8	8		64

misdeed is recognized as the cause of the misfortune. Example: Why did the son die in operation? "It was fate."

4. *Naturalistic*. When the coincidence between a misdeed and misfortune is explained on the basis of chance and the natural cause of the misfortune is recognized independent of the misdeed, the answer is placed in this category. Example: The cow died because it was sick or had eaten something poisonous. Would it have died if the owner had not played tricks? "Yes."

Table 3 shows differences in the responses of males and females to be insignificant, but gives a consistently higher frequency of the idea of immanent

TABLE 4
RESPONSES OF SUBJECTS IN SCHOOL

Group	N	Moslems Per cent of responses				N	Christians Per cent of responses			
		Imma- nent	Mixed	Destiny	Natural- istic		Imma- nent	Mixed	Destiny	Natural- istic
Ages 6-8										
Number of subjects	54					78				
Number of responses	162	79	9	—	12	228	68	23	—	9
Ages 9-11										
Number of subjects	105					39				
Number of responses	315	73	16	—	11	117	79	18	—	3
Ages 12-14										
Number of subjects	74					51				
Number of responses	222	64	22	2	12	153	59	16	1	24
Ages 15-17										
Number of subjects	27					10				
Number of responses	81	20	48	19	15	30	20	40	13	27
Ages 18-25										
Number of subjects	35					68				
Number of responses	105	18	6	8	68	204	13	10	8	69

justice among the responses of females than among males at all age levels, 6 to 25. Likewise, Table 4 shows no reliable difference between the responses of Moslems and Christians.

The differences between elementary-school children, ages 6 to 12, and secondary-school children, ages 12 to 17, are striking. It is interesting that the high-school group, although it shows a decrease in the idea of immanent justice, does not jump immediately to naturalistic thinking but goes through an intermediate level of thinking, as it were. There is due recognition of natural phenomena—the bridge falling because it is old, the finger being cut because the knife slipped—but there is still the tendency to see the need for punishment. The coincidence is more than chance. The bridge would have fallen anyway because it was old, but the boy who stole the apples was perhaps led to pass at that particular moment to get a deserved punishment.

The difference between the high-school (ages 15 to 17) and college group (ages 18 to 25) is large. The proportion of naturalistic answers among the college group is nearly four times as great as among the secondary-school group.

Comparison of our results with those of Piaget shows a higher frequency of the idea of immanent justice among our subjects of 9 to 12 years of age than among Piaget's subjects. While the two sets of findings seem to be comparable below that age, the decrease in immanent justice with age seems to be slower among our subjects than among Piaget's subjects, which suggests that age alone is not enough to cause it, and shows possibly that the cultural factor becomes increasingly important with increasing age. The percentages given by Piaget (3, p. 251) based on questioning 167 children from Geneva and the Varedois Jura are as follows: age 6, 86 per cent; ages 7 to 8, 73 per cent; ages 9 to 10, 54 per cent; and ages 11 to 12, 34 per cent.

As was noted before, the first marked diminution in clear-cut immanent-justice responses among our Lebanese subjects begins with the high-school group. It is difficult to say at this point what is the role of each of two independent variables—age and educational level—in this diminution, in the increase in mixed responses on the high-school level, and in the rise in naturalistic responses on the college level.

Comparison of the responses of our college group, 18- to 25-year-olds, with 18- to 25-year-old illiterates (see Table 5) may throw some light on this subject. Here again the comparison is partly handicapped by the fact that in the absence of mental tests standardized for the country it was not possible to control the mental age. In the present condition of educational opportunities in Lebanon, however, the author has no reason to assume that the illiterates possess a lower mental capacity. They were chosen at random, mostly from

rural areas, where literacy is very low. The differences between the responses of the educated and uneducated groups of the same age are very striking. For example: the responses of college students are 67 per cent naturalistic, while only 8 per cent of the responses of illiterates of college age and 6 per cent of the responses of those between 25 and 45 years of age are naturalistic.

TABLE 5
RESPONSES OF COLLEGE STUDENTS AND ILLITERATES

Group	Per cent of responses				Total
	Immanent	Mixed	Destiny	Naturalistic	
College (18-25 years) ^a	14	12	7	67	100
Illiterates* (18-25 years) ^b	64	17	11	8	100
Illiterates* (25-45 years) ^c	52	34	8	6	100

^a Number of subjects = 103; number of responses = 309.

^b Number of subjects = 57; number of responses = 171.

^c Number of subjects = 23; number of responses = 69.

* It will be noted that between the two groups of illiterates, the older group less often cites immanent justice as being responsible for misfortunes. The frequency of mixed answers from the older group of illiterates is twice that from the younger group of illiterates.

D. SUMMARY AND CONCLUDING REMARKS

A study was made of the frequency of the idea of immanent justice among various Lebanese groups. The younger group was composed of 539 subjects, in elementary and secondary schools and in college. The older group consisted of 125 persons, all out of school. Eighty of these were illiterates; the rest had had some high-school education. Both older and younger groups were mixed in respect to sex and religion.

The younger subjects, excluding the college group, were questioned on three stories used by Piaget. For the college students and out-of-school subjects, a set of three new stories meaningful for older people in the Lebanese culture were used. The responses were grouped under four categories—immanent justice, mixed (immanent and naturalistic), destiny, naturalistic.

The incidence of the idea of immanent justice in our subjects below 8 years of age is comparable to that of Piaget's. While Piaget's group shows a considerable drop beginning with age 9, ours shows no diminution, suggesting that, at this age level, cultural influences become important, and increased mental age alone does not diminish moral realism. This is in agreement with Piaget's observations and Abel and Dennis' findings (2).

Among our subjects in school the diminution in the idea of immanent justice begins in high school and becomes marked with ages 15 to 17.

Reduction in frequency of immanent justice is not immediately accompanied by a proportionate rise in naturalistic thinking. Mixed answers and the concept of destiny act as intermediate steps.²

On the college level naturalistic thinking is prominent and clear-cut. The striking differences between the responses of illiterate 18- to 25-year-olds and college students show that educational and social factors are effective in changing thinking connected with immanent justice.

The frequency of "immature" thinking among illiterate adults in Lebanon is as high as among elementary-school children.

The author considers the findings in this study of particular interest from the standpoint of the role of culture in moral thinking.

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² This does not imply that destiny is nothing but an intermediate step. It should be taken as such in this context (unfortunate event preceded by misdeed). The concept of destiny deserves an independent study although its appearance here is interesting.

SOME DIFFERENCES IN THE FAMILY RELATIONSHIPS OF ACHIEVING AND UNDERACHIEVING READERS*

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A. INTRODUCTION

The causes of reading disability have shifted from physiological factors only, to psychological factors only, to a combination of the two, and then back to physiological factors, which begins the cycle over again. Among the psychological factors that have been considered inherent in reading difficulties has been the one of poor interfamily relationships. The word "poor" may be conceptualized differently by different people. Overdependence upon family members and a tendency to exclude all outsiders, no matter how "nice" this may seem to some parents, may be considered a poor family relationship just as much as that of complete family rejection.

The purpose of the present study was to ascertain the differences, if any, in the family relationships of good and poor readers. The investigators assumed a null hypothesis—that there is no significant difference between the family relationships of good readers and those of poor readers.

B. METHOD

1. *Subjects*

Twenty-two boys and 22 girls from the Rockford College Reading Clinic in Rockford, Illinois, composed the group of children who were reading below their anticipated grade placement based on their *IQ* scores. This group will henceforth be referred to as the underachieving readers.

Twenty-two boys and 22 girls from Marsh School in Rockford, Illinois, composed the group of children who were reading at their anticipated achievement grade placement according to their *IQ* scores. The Marsh School children were all reading above their present grade level, but because of their above-average *IQ* scores their anticipated achievement grade placement was, in every case, above their present grade level, and thus they were considered achieving readers only.

Both groups of children scored average or above on *IQ* tests (100-137),

* Received in the Editorial Office, Provincetown, Massachusetts, on July 16, 1965. Copyright, 1966, by The Journal Press.

were from similar socioeconomic backgrounds, and were all between the ages of 8 and 12.

2. The Test

Though the "Two Houses Technique" test is itself unpublished, its creator, Doctor Victor Szyrnski, Professor of Psychiatry at the University of Ottawa, has published two articles regarding his use of the test. One appeared in the *Canadian Psychiatric Association Journal* (2), and the other appeared in *Psychosomatics* (1).

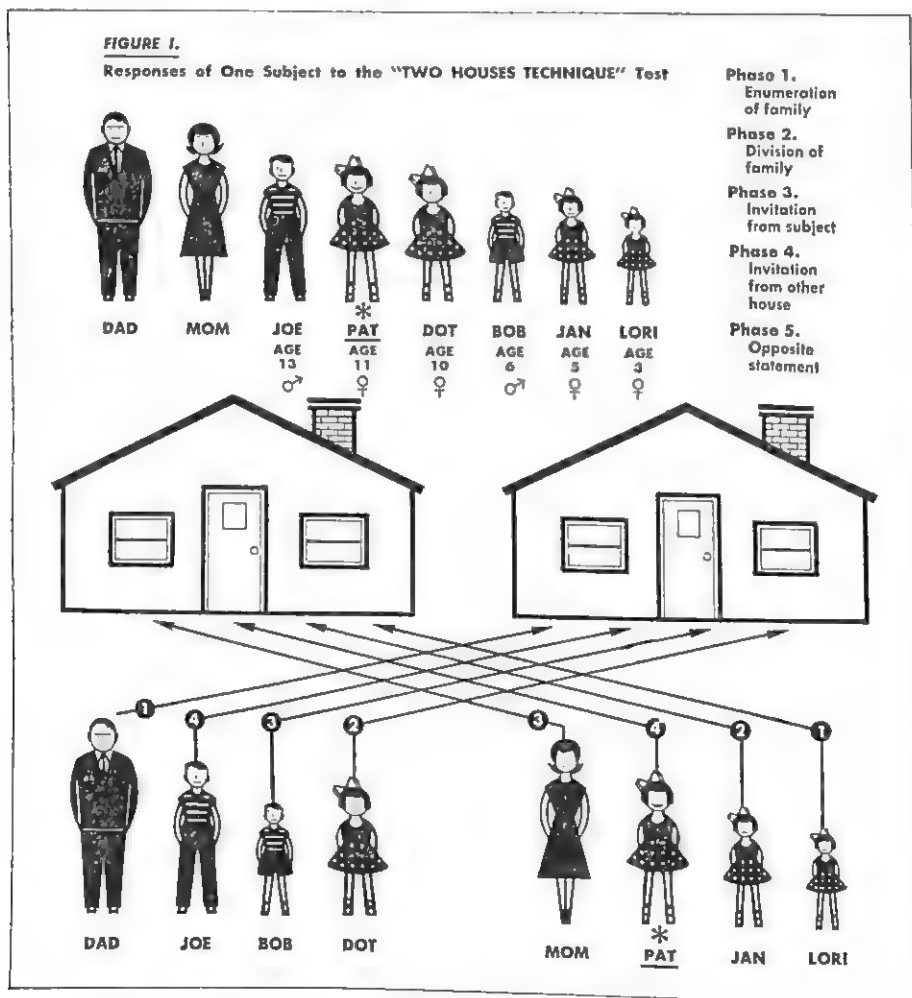


FIGURE 1
RESPONSES OF ONE SUBJECT TO THE TEST

The "Two Houses Technique" test is composed basically of five phases. In the first phase the child is asked to enumerate the family members (see Figure 1). The examiner draws stick figures across the top of a large white sheet of paper as the child names the members of his family. In the second phase, the child is asked to place the family members into two houses that the examiner has drawn on the paper. Again the examiner draws stick figures below the houses in which the child places each member. The child is then told to invite, one by one, the members of the other house over to the house in which he has placed himself. In this third phase the examiner shows the movement with lines from the persons to the house. The procedure is reversed in the fourth phase when the child sends members in his house over to the other house. The fifth stage or phase of the test involves the "opposite statement" verification wherein the examiner, after observing which member seems most rejected, will say, "You like best to play with John?" whereby the child usually says something like, "Oh no, I like to play with Jane best."

Signs and symbols are used by the examiner as he administers the test. During testing he observes the child's general behavior and notes comments and gestures that are irrelevant to the test tasks. Possible interpretations are given for all responses in each phase of the test.

Among other things, the "Two Houses Technique" test attempts to show the amount of emancipation from the home, the amount of sibling interaction and sibling rivalry, and some indication of the child's identification with parents based on the sex of the child.

3. Procedure

The "Two Houses Technique" test, as described above, was administered individually to each child of the two groups. When the child came into the testing room, a brief warm-up period, with a general discussion, was allowed for the purpose of putting the child at ease. Care was taken not to mention the child's family at this point. Upon completion of the examination, the child was assured that all members of his family were now living together in one house just as before. When this assurance has been omitted, some children have later become anxious over the separation.

The placements and movements in each test were scored and the two groups were compared in five different combinations: (a) achieving boys with underachieving boys, (b) achieving girls with underachieving girls, (c) achieving boys with achieving girls, (d) underachieving boys with underachieving girls, and (e) achieving boys and girls with underachieving boys and girls. Levels of significance were obtained by computing the percentages in

TABLE 1
SIGNIFICANT DIFFERENCES IN THE FAMILY RELATIONSHIPS OF ACHIEVING AND UNDERACHIEVING READERS

Significant items	% of good read. (Boys)	% of poor read. (Boys)	Sig. level	% of good read. (Girls)	% of poor read. (Girls)	Sig. level	% of good read. (Boys)	% of good read. (Girls)	Sig. level (%)
Placed self with mother and sibs.	0	4	—	36	10	5	0	36	1
Placed self with sibs. only	50	50	—	10	36	5	50	10	1
Separates self from father	0	10	—	36	18	—	0	36	1
Placed parents least sig. position	0	18	5	4	10	—	0	4	—
Placed self with father and sibs.	27	4	5	18	4	—	27	18	—
Separated self from some sibs.	55	41	—	64	27	5	55	64	—
Placed self in chron. order	4	0	—	4	18	—	4	4	—

TABLE 1 (*continued*)

Significant items	% of poor read. (Boys)	% of poor read. (Girls)	Sig. level	% of good read. (B & G)	% of poor read. (B & G)	Sig. level (%)
Placed self with mother and sibs.	4	10	—	18	7	—
Placed self with sibs. only	50	36	—	30	43	—
Separates self from father	10	18	—	18	14	—
Placed parents least sig. position	18	10	—	2	14	5
Placed self with father and sibs.	4	4	—	28	5	1
Separated self from some sibs.	41	27	—	59	34	5
Placed self in chron. order	0	18	5	5	9	—

the compared groups that exhibited certain behavior and then finding the significance of the difference between the percentages via the critical ratio.

C. RESULTS

Except where indicated, all the following results were significant at the 5 per cent level of confidence (see Table 1). No achieving boys, but 18 per cent of the underachieving boys placed their parents in the least significant position. Twenty-seven per cent of the achieving boys and 4 per cent of the underachieving boys placed themselves in a house with the father and one or more siblings. Thirty-six per cent of the achieving girls and 10 per cent of the underachieving girls placed themselves in the house with the mother and one or more siblings. Ten per cent of the achieving girls and 36 per cent of the underachieving girls placed themselves in the house with siblings only. Sixty-four per cent of the achieving girls and 27 per cent of the underachieving girls separated themselves from some of their siblings. Thirty-six per cent of the achieving girls placed themselves with their mothers and one or more siblings, while no achieving boys placed themselves in that position which was significant at the 1 per cent level of confidence. Also significant at the 1 per cent level of confidence was the placement of 50 per cent of the achieving boys in the house with siblings only, while only 10 per cent of the achieving girls did so.

Thirty-six per cent of the achieving girls and no achieving boys separated themselves from their fathers (significant at the 1 per cent level of confidence). Eighteen per cent of the underachieving girls and no underachieving boys placed themselves in chronological order in the family enumeration process. Two per cent of all the achieving children and 14 per cent of the underachieving children placed the parents in the least significant position. Fifty-nine per cent of the achieving children and 34 per cent of the underachieving children separated themselves from some of the siblings. Twenty-eight per cent of the achieving children and 5 per cent of the underachieving children placed themselves in the house with their fathers and one or more siblings, which was significant at the 1 per cent level of confidence.

D. DISCUSSION

1. *Summary*

The "Two Houses Technique" test was administered to 22 girls and 22 boys, who were underachieving readers from Rockford College Reading Clinic, and 22 girls and 22 boys, who were average achieving readers from Marsh School, to ascertain the differences in the family relationships of the

two groups. The null hypothesis—that there is no significant difference between the family relationships of the average achieving and underachieving readers—was assumed. Comparison of the groups in five different combinations indicated many significant differences at the 5 per cent level of confidence and a few significant differences at the 1 per cent level of confidence. These differences indicate that more underachieving boys than achieving boys consider their parents the least significant members in the family, and that more achieving boys than underachieving boys identify with their fathers and interact with some siblings.

Achieving girls identify with their mothers and reject some siblings more than underachieving girls, but underachieving girls interact with siblings more than achieving girls.

Achieving girls identify with mothers more than achieving boys do. Achieving boys identify with fathers more than achieving girls do, and achieving boys interact with siblings much more than achieving girls do.

The underachieving readers did not place their parents in as significant positions as did the achieving readers, and they did not separate themselves from siblings as much as the achieving readers did.

2. *Conclusions*

One might infer from the results of this study that achieving girls tend to identify with mothers and to reject siblings more than do underachieving girls, while the underachieving girls tend to be more dependent upon siblings than do the achieving girls; that achieving boys tend to identify more with fathers than do the underachieving boys; and that there is more sibling rivalry among achieving girls and more interaction with siblings among achieving boys than among any other group.

Since more underachieving girls than underachieving boys placed themselves in chronological order in the enumeration of family members process, one might assume that underachieving girls are more comfortable in the family group than are underachieving boys.

The underachieving groups' dependency upon siblings rather than identification of boys with fathers and girls with mothers might be considered to constitute poor family relationships in our culture. The achieving groups' identification with parents and their accepting-rejecting attitude with siblings are generally considered to be healthy family relationships in our culture.

The purpose of the study was to ascertain the differences, if any, in the family relationships of achieving and underachieving readers. The "Two Houses Technique" test, used in this study, indicates that there are significant

differences between the family relationships of the achieving readers and those of the underachieving readers. Further investigation with this test seems desirable.

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PERCEIVED MATERNAL CHILDREARING HISTORY AND SUBSEQUENT MOTIVATIONAL EFFECTS OF FAILURE*¹

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A. INTRODUCTION

The contention that the nature of the relationship between mother and child has a primary influence upon the eventual psychological adjustment of the child no longer requires documentation. However, rigorous specification of the relevant maternal behavior dimensions, the child adjustment dimensions, or the functional relationships that exist between them lags far behind clinical speculation. This is understandable when the extremely complex nature of a mother-child relationship over the long developmental period is considered along with the multitude of other influences upon the ultimate adjustment of the child. In addition, if an investigator is interested in the mother-child relationship as it relates to the genesis of a disorder that makes its appearance clinically evident long after the major influences of the mother have been exerted (e.g., schizophrenia), retrospective analysis with its inherent difficulties becomes necessary.

Rodnick and Garmezy (27) have urged that knowledge about the schizophrenic process will fall into sharper focus when (and if) it can be shown that explanatory principles are the same as those that hold for normal behavior. Since they propose that much of the deficit behavior of the schizophrenic can be traced to the mother-son relationship, the possibility exists that more rigorous examination of maternal childrearing characteristics and the subsequent appearance of deviant behaviors in grossly normal offspring will clarify not only the principles of normal psychological development but will also cast some light on the genesis of schizophrenia. Meehl's recent paper (25) can also be interpreted as sanctioning this avenue of investigation into the antecedents of psychopathology. Although Meehl proposes that schizophrenia has a genetic predisposition, the precipitating factors are conceived of as environmental in character and not qualitatively distinct from the stresses that are experienced

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¹ This experiment was conducted while the senior author was a visiting Associate Professor of Psychology at the University of California, Berkeley.

by normals. Again the mother-child relationship was singled out as a major precipitating factor.

Rodnick and Garmezy have hypothesized that the schizophrenic demonstrates inferior cognitive performance under conditions that include exposure to social criticism. This, in turn, was related to a sensitivity to social censure developed in the relationship with a controlling but rejecting mother. Rodnick and Garmezy account for cognitive deficit under conditions involving censure by assuming that responses that are incompatible with the relevant cognitive response are elicited by censure.

Heilbrun, Orr, and Harrell (16) have found support for the Rodnick-Garmezy hypothesis in the behavior of normal Ss. Employing the two major maternal childrearing dimensions of overcontrol *vs.* granting of autonomy and nurturance *vs.* hostility (28, 30, 33), four childrearing types were defined: (a) "accepting" (low control-high nurturant), (b) "rejecting" (high control-low nurturant), (c) "overprotective" (high control-high nurturant), and (d) "ignoring" (low control-low nurturant).

Perceptions of maternal and paternal childrearing attitudes were obtained from normal college males. These Ss then performed a concept formation task designed to be of sufficient difficulty to provide some degree of failure experience and to enhance the critical properties of each "wrong" response emitted by the experimenter. *E* was a woman with college-age sons of her own, and was presumably capable of eliciting responses from the male Ss similar to those characteristic of their responses to criticism from their actual mothers. Since sons of "rejecting" mothers would be expected to show the lowest self-esteem and self-confidence, it was predicted that they would be inferior in cognitive performance to the most adjustive "accepting" mother group. This prediction held for all four error scores. The conceptual performances of the remaining two groups tended to assume an intermediate position but were not significantly inferior to the most adjustive group. It can be noted that this study provides a parallel in the history and experimental behavior of unselected male normals to the Rodnick-Garmezy conjectures about cognitive deficit in male schizophrenics. The same pattern of results was obtained when perceived paternal childrearing history was related to conceptual performance.

The purpose of the present experiment was to extend the findings and implications of the Heilbrun, Orr, and Harrell investigation by studying the relationships between perceived maternal childrearing history of normal males and motivational behavior. Specifically, it would follow from the proposed differences in self-esteem and self-confidence between "rejected" and "accepted"

males that "rejected" Ss would be more influenced in their goal-setting behaviors following failure than would "accepted" Ss. There is ample experimental evidence indicating a negative relationship between modifiability of behavior and self-esteem. Hovland and Janis (17) have hypothesized persuasibility to be a negative function of self-esteem, and studies by Gelfand (8) and Heilbrun (13) provided evidence consistent with this hypothesis. Other studies (29, 34, 35) have indicated that tendencies to model one's behavior after another person is negatively related to self-esteem.

The following predictions were made regarding the effects of failure upon goal-setting responses:

1. Male Ss reared by mothers perceived as "accepting" (low controlling and high nurturant) will be the most stable and the most positive in their goal-setting behavior under failure conditions.

2. Male Ss reared by mothers perceived as "rejecting" (high controlling and low nurturant) will be the least stable and the least positive in their goal-setting behavior under failure conditions.

3. Males reared by mothers perceived as "ignoring" and "overprotective" (low controlling-low nurturant and high controlling-high nurturant, respectively) will show intermediate stability and positiveness in their goal-setting behavior under failure conditions.

B. METHOD

1. *Subjects*

The 61 Ss included in the experiment were male college undergraduates obtained as volunteers from large classes or obtained as paid participants through a university employment service. All were attending the University of California, Berkeley, during the spring semester, 1964. The mean age was 20.8 years. The average family for these Ss included .6 older sibs and 1.0 younger sibs.

2. *Experimenter*

As in the earlier Heilbrun, Orr, and Harrell experiment, the junior author acted as experimenter. She was of about the same age as would be expected for the mothers of the Ss and had conducted the experiment from the beginning in such a way as to communicate the paramount importance of S's cooperation to the success of *her* investigation. E's physical appearance and encouragement of S's sense of responsibility to her were intended to create a relationship bearing some similarity to the actual mother-son relationship, so that responses

characteristic of earlier failure experiences mediated by the mother would be more likely elicited.

3. *Developmental Measures*

Perception of maternal childrearing behavior was assessed by obtaining the son's ratings on two questionnaires. The Parent Attitude Research Instrument, PARI (32), was administered to S with instructions to complete it as his mother would. The PARI includes 115 statements of childrearing attitude with four response options ("strongly agree," "mildly agree," "mildly disagree," and "strongly disagree"). Four points are assigned to a "strongly agree" response down to one point for "strongly disagree." The 23 attitude scales are comprised of five statements each. Sixteen of these 23 scales have been identified as a major factor by two independent factor analyses (31, 37); both sets of investigators identified the factor as an indicant of "authoritarian-control" childrearing tendencies. Cumulative scores on these 16 scales² defined perceived maternal control in this experiment with the possible range of scores ranging from 80 (low) to 320 (high).

The PARI as a measure of perceived maternal control has received validation support from three sources. For one, findings from studies employing a wide variety of assessment procedures (self-report of the mother, perception of the children, observation of the mother-child interaction) concur that a negative relationship exists between maternal control and the offspring's level of adjustment (1, 4, 5, 6, 7, 9, 10, 19, 20, 21, 22, 23, 26, 36). Previous studies in which the PARI has been employed as a measure of perceived maternal control have shown the predicted negative relationships between maternal control and adjustment of the offspring, with the Ss ranging from hospitalized schizophrenics (11, 24) to grossly normal college students (3, 15).

Second, perceived maternal control scored from the PARI was found to be positively related to a similar index obtained from selected TAT cards by Daniel (3).

A third confirmation of the utility of PARI perceived control scores follows from their use in studies in which predictions based upon theory have received support. Heilbrun and Hall (14) used the PARI in testing the social power theory of identification, and the experiment by Heilbrun, Orr, and Harrell

² Fostering dependency, seclusion of mother, breaking the will, martyrdom, fear of harming the baby, excluding outside influence, deification, suppression of aggression, approval of activity, avoidance of communication, inconsiderateness of husband, suppression of sex, ascendance of mother, intrusiveness, acceleration of development, and dependency of mother.

(16) confirmed predictions based upon Rodnick and Garnezy's theory of cognitive deficit (27).

Perceived nurturance of the mother was estimated from *S*'s ratings upon the Parent-Child Interaction Rating Scales (12). This measure includes eight related modes of maternal nurturant behavior;³ each of the eight ratings was made on a five-point, descriptively anchored scale and a cumulative total score was assigned. The possible range of attributed maternal nurturance scores extends from 8 (low) to 40 (high). These scales have also received validation support (12, 14, 16).

4. Procedure

Ss were administered the PARI and the Parent-Child Interaction Rating Scales (in that order) in small groups by *E*, who identified the study as her own. From a half day to six weeks later, *Ss* were recalled individually for the experimental session.

a. Spatial discrimination task. The first experimental task was a slight modification of a visual discrimination procedure employed with children by Crandall (2) and initially devised by James (18). *S* was seated about eight feet away from and facing a board upon which was mounted a row of five six-inch white disks. Centered on each disk was a different-sized angle, varying by 10-degree steps from 45 to 85 degrees. In addition, the lower legs of the angles differed by five-degree steps from each other relative to the horizontal, varying from 10 degrees below the horizontal to 10 degrees above. Circular mounts and variable slopes for the lower legs were intended to increase the difficulty of discrimination by minimizing traditional horizontal and vertical frames of reference and thereby reducing the possibility of *S*'s discovering the bogus nature of the task.

S was instructed that he was to be tested for his ability to make spatial discriminations and that he was to be shown 20 angles like those mounted in front of him; in each case he was to match the test angle with its identical counterpart among the five standard angles. *S* was then informed that high school students, on the average, get 10 out of 20 correct, and *S* was asked at that point to estimate the number he expected to match correctly out of 20: i.e., his Pretrial 1 level of aspiration (LOA_1).

The 20 test angles included five each of four different angle sizes (50, 60, 70,

³ Degree of felt affection, degree of physically-expressed affection, approval of *S*, acceptance of *S*'s personal feelings and experiences, concrete giving, positive encouragement, degree of trust, and sense of security felt by *S*.

and 80 degrees). Since each angle size fell midway between two of the standard angles, there were no correct matching responses possible. The test angles were presented one at a time on five- by six-inch cards in a fixed order arranged so that *S* would not be presented the same-size angle nor the same angle slope on two consecutive cards. Summarily, the task conditions were such as to allow *E* to present fixed schedules of right-wrong reinforcement without creating any obvious suspicion in the *Ss*.

On Trial 1, all *Ss* were given five positive reinforcements ("right") (items 3, 4, 9, 12, and 17) and 15 negative reinforcements ("wrong"). This provided a clear failure experience, falling from one to 15 below the LOA_1 responses of the group and five below the bogus high school norm for number correct. *S*, after being informed of his score of five, was then asked to make a second estimate of performance upon repetition of the task (LOA_2).

Prior to Trial 2 the standard angle cards were rearranged on the board from their Trial 1 order (from *S*'s left to right) of 45, 85, 75, 55, and 65 degrees to the reversed order, 65, 55, 75, 85, and 45 degrees. *Ss* again attempted to match each of the 20 test angles with its "exact" standard counterpart and were again provided a failure experience of but six "correct" responses (items 2, 5, 8, 9, 13, 17), and 14 "incorrect" estimates. This bogus performance level fell about 3.7 below the mean estimate for the group. Following Trial 2, *Ss* were again requested to estimate performance on a third and last trial (LOA_3).

Ss were allowed a relatively successful discrimination experience on Trial 3 with a fixed reinforcement schedule of 13 "right" responses emitted by *E* and seven "wrong." This was included in the experimental procedure in hope of minimizing the effects of failure in the first experimental task upon the one that followed.

Self-evaluative responses should be related to goal-setting behavior on the discrimination task in two ways. *More positive self-esteem should lead to the greater stability of LOA following the first failure experience. Further, more positive self-evaluation should result in maintaining high LOA relative to inferior performance baselines.*

b. Risk-taking task. *Ss* were next given 100 poker chips and told that they were to engage in a guessing game in which they were to bet on the outcome of their guesses. *E* informed them that she was going to think of a number and *S* was to guess whether it was odd or even, with a 50-50 chance of being correct. Before each of 10 guesses *S* would be asked to bet a minimum of one chip up to a maximum of half those in his possession at the time. If wrong, *S* would lose the number of chips bet; if right he would be paid an equal number. Finally, he was told that whichever *S* had the largest number of chips in his

possession at the completion of the 10th trial would be awarded a prize of \$20.00 upon termination of the entire experiment.

A fixed and losing schedule of reinforcement was imposed upon each *S* with "right" being emitted after the third, seventh, and tenth guesses and "wrong" after the remaining seven guesses.

Even though there is a clear distinction between spatial discrimination and guessing odd or even in the apparent contingency between *S*'s personal adequacy and reinforced outcome, there remains a skills element to the risk-taking task that does allow for predictions to be generated. *S*'s assignment in the betting procedure is to employ some strategy or strategies of betting that will maximize the chips in his possession after the final bet. If "rejected" males (relative to "accepted" *S*s) tend to revise their goals more radically following failure when failure reflects upon their personal adequacy, it would be expected that "rejected" *S*s also would revise their goal-setting strategies more radically when they have been unsuccessful than would "accepted" *S*s. The principle in either case is the same. The "rejected" male's self-confidence is more seriously threatened by failure of any kind than is the "accepted" male's self-confidence, and his subsequent goal-setting behavior will reflect this decreased self-confidence: (a) he will reduce his level of aspiration more to bring it in line with the poor level of performance, and (b) he will give up more readily than the "accepted" male on self-devised goal-setting strategies that have been unsuccessful.

The specific prediction on the risk-taking task was that *the goals set (i.e., per cent bet) after losing guesses by the "rejected" group would be more variable than the goal-setting responses of "accepted" Ss*. It was anticipated that "overprotected" and "ignored" groups would assume intermediate performance positions with respect to goal-setting variability.

C. RESULTS

The 61 *S*s were assigned to one of four maternal control pattern groups by splitting the PARI and nurturance scale distributions at their respective medians (193 and 31, respectively) and using these cutting points to define high and low status. The resultant *N*s are found below in Table 1.

1. Spatial Discrimination Task

Three scores were used to evaluate the effect of failure upon level of aspiration: (a) LOA_2 minus LOA_1 , (b) LOA_2 minus "performance" on Trial 1 (i.e., $LOA_2 - 5$), and (c) LOA_3 minus "performance" on Trial 2 (i.e., $LOA_3 - 6$). Table 1 presents the LOA score means and *SD*s for the

TABLE 1
CHANGE IN LEVEL OF ASPIRATION AS A FUNCTION OF NEGATIVE SOCIAL REINFORCEMENT FOR MALE GROUPS
DIFFERING IN MATERNAL CONTROL PATTERN HISTORY

Level of aspiration score ^a	Type of maternal control pattern										
	"Accepting" mothers (<i>N</i> = 21)		"Rejecting" mothers (<i>N</i> = 20)			"Overprotective" mothers (<i>N</i> = 9)			"Ignoring" mothers (<i>N</i> = 11)		
	Mean	<i>SD</i>	Mean	<i>SD</i>	<i>t</i> ^b	Mean	<i>SD</i>	<i>t</i> ^b	Mean	<i>SD</i>	<i>t</i> ^b
LOA ₂ —LOA ₁	—4.05	2.57	—6.25	2.77	2.59**	—4.89	2.64	.78	—4.45	3.58	.35
LOA ₂ —5	4.52	2.78	3.00	1.73	2.05*	3.22	2.78	1.13	3.73	3.44	.69
LOA ₃ —6	2.19	1.62	1.70	1.45	1.00	3.00	2.36	1.04	2.27	2.50	.11

^a Minus LOA₂—LOA₁ scores indicate a decrease in LOA as a function of an intervening failure experience; plus LOA₂—5 and LOA₃—6 scores indicate the extent to which LOA exceeds scores obtained on prior failure trials.

^b These values refer to statistical comparisons with the "accepting" group.

* $p < .05$, one-tail.

** $p < .005$, one-tail.

four control pattern groups and the results of statistical comparisons between the "accepted" reference group and the remaining three groups. As predicted, the "accepted" group showed the least change in LOA after the first failure experience ($LOA_2 - LOA_1$), the "rejected" group demonstrated the most change, and "overprotected" and "ignored" group change scores were intermediate in value; all mean scores indicated a decrement in LOA. The "accepted" and "rejected" group means differed significantly ($p < .005$) as was predicted.

In addition, the "accepted" group maintained the highest LOA relative to fictitious performance level on Trial 1 ($LOA_2 - 5$), the "rejected" group the lowest, and the "overprotected" and "ignored" S s were again intermediate. Consistent with prediction, "accepted" and "rejected" group means differed significantly ($p < .05$).

Following the second failure trial, no significant differences between groups were obtained ($LOA_3 - 6$). Although the "rejected" group still provided the lowest LOA relative to a bogus standard of performance, the rank order of the remaining three groups no longer corresponded to prediction.

2. Risk-Taking Task

Stability of goal-setting behavior was indicated by the standard deviation of per cent bet on the seven trials following a losing choice. A standard deviation or a similarly devised score was required because it was necessary to consider the absolute rather than the algebraic deviation of the bets from one another and because a single score was desired that would summarize the variability of all seven bets.

Inspection of the four SD score distributions for the experimental groups suggested bimodality rather than normality (i.e., S s tended to vary a great deal or very little in per cent bet); accordingly, both parametric and nonparametric statistical analyses were conducted. Data relevant to betting variability for the four experimental groups are reported in Tables 2 and 3. The only statistically significant findings were parametric and nonparametric support for the predicted higher variability of betting responses of "rejected" S s relative to "accepted" S s. Rather than assuming positions of intermediate goal-setting variability, "overprotected" S s were highly similar to the "accepted" S s and "ignored" S s to the "rejected" group.

The possibility existed that an S could employ a single tactic throughout the series of bets, but the tactic itself would involve substantial variability from trial to trial (e.g., doubling the number of chips bet following a loss).

TABLE 2
STANDARD DEVIATION OF PER CENT BET SCORES AS A FUNCTION OF NEGATIVE SOCIAL REINFORCEMENT FOR MALE GROUPS
DIFFERING IN MATERNAL CONTROL PATTERN HISTORY

Type of maternal control pattern												
"Accepting" mothers (<i>N</i> = 21)			"Rejecting" mothers (<i>N</i> = 20)			"Overprotective" mothers (<i>N</i> = 8) ^a			"Ignoring" mothers (<i>N</i> = 11)			
Mean	<i>SD</i>	<i>SD</i> of <i>SD</i>	Mean	<i>SD</i>	<i>SD</i> of <i>SD</i>	<i>t</i> ^b	Mean	<i>SD</i>	<i>SD</i> of <i>SD</i>	<i>t</i> ^b		
8.10		6.53	11.15		6.06	1.68*	7.84		5.83	.11	11.21	
											6.38	1.43

^a Reduction in this group from *N* = 9 to 8 resulted from a recording error during the risk-taking task for one *S*.

^b These values refer to statistical comparisons with the "accepting" group.

* *p* = < .05, one-tail.

TABLE 3
CHI SQUARE COMPARISONS^a BETWEEN "ACCEPTING" AND REMAINING THREE GROUPS

Subjects	"Accepting"	"Rejecting"	"Accepting"	"Overprotective"	"Accepting"	"Ignoring"
Above combined <i>SD</i> median	7	14	3	12	9	7
Below combined <i>SD</i> median	14	6	5	9	12	4
	$\chi^2 = 4.14^*$		$\chi^2 = .28$		$\chi^2 = .55$	

^a With Yates' correction.

* $p < .05$, one-tail.

Inspection of the betting percentages for each *S* failed to indicate the operation of this prearranged type of systematic betting pattern.

The underlying premise that all *Ss* approached the termination of the betting task having experienced failure (objectively defined) was substantiated. The mean number of chips in their possession at the time of their last bet was approximately 34 out of the original 100 ($SD = 33$); the range of total chips possessed was from 2 to 97.

D. DISCUSSION

The findings of this experiment provided clear support for the predicted difference in goal-setting behaviors under failure conditions for males perceiving their mothers as "accepting" (low control-high nurturance) and as "rejecting" (high control-low nurturance). "Rejected" *Ss* displayed more decrement in LOA following poor performance on a visual discrimination task and maintained a lower LOA relative to performance level than did the "accepted" *Ss*. In addition, "rejected" *Ss* showed more variability in their betting responses on a risk-taking task under a losing schedule of reinforcement when compared to the "accepted" group. Both sets of results indicate that the "rejected" male more readily modifies his goals subsequent to failure than does the "accepted" male. These results extend those previously reported by Heilbrun, Orr, and Harrell (16). In the earlier study, normal college males who reported a "rejecting" maternal childrearing pattern were inferior in concept formation performance to "accepted" males when variable amount of negative evaluation by an adult female was part of the procedure. The present results extended these findings by holding objective success-failure of performance level constant and demonstrating differential effects of failure upon motivational variables associated with goal-directed behavior.

The hypothesized mediating factor between perceived childrearing experience and experimental performance for the initial and present experiments remains the same. Maternal childrearing behaviors viewed by the child as highly controlling and low in nurturance would tend to inhibit the development of self-esteem and self-confidence by the direct effects of maternal criticism and limited affection and the indirect effects of restricting the learning of socially competent behaviors. Limited social competence would tend to elicit additional critical responses from nonmaternal social objects. Both the immediate and mediate effects of perceived maternal rejection should result in an increased sensitivity to negative social reinforcement or to conditions that might elicit it (e.g., failure). Thus, in the present experiment, given failure, "rejected" *Ss* expressed less confidence than "accepted" *Ss* in their spatial discrimination

ability by dropping their LOA more than "accepted" Ss, and indicated less confidence than "accepted" Ss in their strategy of betting by greater variance in per cent of chips wagered. The present results also allow for the interpretation that the influence of failure upon the behavior of "rejected" Ss tends to generalize to situations wherein the person's self-esteem would seem to be only minimally called into question.

The initial Heilbrun, Orr, and Harrell and the present experiments suggest three behavioral consequences of negative social reinforcement or failure for young males reporting "rejecting" maternal childrearing histories. One, on more complex tasks responses incompatible with task-relevant cognitive behaviors are elicited and inferior cognitive performance ensues. Two, goals are dropped to bring them in line with inferior performance. Three, modes of approach to a goal are relinquished when they meet with failure. It is clear that these do not represent unique modes of response to negative social reinforcement; "rejected" male offspring differ only in degree relative to the adjustive "accepted" group.

Data from the earlier Heilbrun, Orr, and Harrell study indicated that given a relatively easy task with minimal failure experience, "rejected" Ss did not differ in conceptual performance from the "accepted" males. Similarly, the LOA₁ data in the present study indicate that prior to the first failure experience the "rejected" group was not characterized by less positive goal-setting behavior than the other groups. The mean LOA₁ scores were as follows: "accepted," 13.57; "rejected," 14.25; "overprotected," 13.11; and "ignored," 13.18. The experimental failure conditions in both studies seem clearly responsible for the ultimate differential behaviors observed.

The performances of the "overprotected" and "ignored" groups are somewhat more difficult to evaluate relative to initial predictions. It was true that neither of these groups was significantly inferior to the "accepted" group on any of the dependent measures and that they provided the predicted intermediate performance scores on the discrimination task. However, the absolute performance levels of these two groups on the betting variability measure were not intermediate to those provided by "accepted" and "rejected" Ss. Until future studies allow for increased sample sizes for the "overprotected" and "ignored" groups, it would appear best to draw no firm conclusions regarding the possible effects of these types of perceived maternal childrearing behaviors.

E. SUMMARY

Research and clinical observation indicate the importance of maternal child-rearing control and nurturance for the subsequent adjustment of male offspring,

normal and schizophrenic. The present experiment tested whether perceived patterns of maternal control and nurturance would relate to the normal son's goal-setting behavior under failure conditions. Sixty-one college males acted as Ss. As predicted, those Ss who rated their mothers as "rejecting" were less stable and less positive in their levels-of-aspiration on a discrimination task and less stable in their betting on a gambling task than Ss rating their mothers as "accepting." It was proposed that failure influenced goal-setting in the "rejected" group more than in the "accepted" group because of lower self-esteem generated by their childrearing history.

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THE CHILD AS A DETERMINANT OF HIS PEERS' APPROACH TO HIM*¹

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A. INTRODUCTION

Previous research has yielded evidence that indicates that children tend to be instrumental in bringing about the kind of approach that their peers make to them. Bott (2) found a rank order correlation of .91 between amount of verbal and motor contacts initiated and verbal and motor contacts received. With respect to quality of behavior, Anderson (1) found that dominative behavior invited domination in return; similarly, integrative behavior invited integrative approaches in return.

These findings are important in relation to personality development and psychotherapy. In his relationship to his peers, the child may create for himself a particular kind of environment that will foster and continue his development in a given direction. Longitudinal research is beginning to yield considerable evidence that many aspects of personality show continuity over relatively long periods of time [see Kagan and Moss (4)]. Such continuity may be, in part, a function of the kind of response that the individual can call forth in others: i.e., existing personality trends are strengthened when they consistently evoke congruent responses from others.

This issue has been a central one in therapy. Freud called attention to repetitive patterns and saw a transference as an outstanding example of the "Repetition Compulsion" (3). He saw the intensity of the transference phenomenon as brought about by the special circumstances of psychoanalysis, but he also saw repetition occurring in everyday life. "What psychoanalysis reveals in the transference phenomenon of the neurotic can also be observed in the lives of normal people. The impression they give us is of being pursued

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by a malignant fate or possessed by some extraneous power; but psychoanalysis has always taken the view that their fate is for the most part arranged by themselves and determined by early infantile influences" (3, p. 23). Probably more congenial than the above to behavior scientists is Sullivan's reformulation of the Repetition Compulsion in terms of "parataxic distortions." Parataxic distortions, according to Sullivan, develop from early but essentially nonsexual integrations with significant others. One develops ways of coping with these people and then tends to apply these ways in later interpersonal integrations (9).

Both the areas of personality development and psychotherapy can benefit when such repetitive patterns, or these tendencies to bring about given kind of interpersonal constellation, can be subjected to systematic research. An intensive pilot study of children in their first year in school provided an opportunity (*a*) to re-examine the correlation found by Bott on frequency of contact initiated and received and (*b*) to examine the relationship between quality of contact initiated and quality of contact received under conditions that differed in two main respects from Anderson's work. In the present study, the children's responses were studied over a long period of time (covering almost a full year), as compared to the brief experimental session from which Anderson derived his findings. Moreover, the conditions of the present study were closer to life than the conditions in Anderson's study; the children had the opportunity to select their peers from the total classroom groups, whereas in the Anderson study they were paired experimentally.

B. METHODS OF PROCEDURE

The children composing the sample were studied intensively for an entire school year as part of a school-entry study, a pilot study on home-school interaction during the child's first year of school. The original sample was composed of 16 children, eight boys and eight girls, chosen from middle- and working-class homes. Five children were lost in the course of the school year, one because the parents refused further cooperation, and four because the parents moved out of the school district. The results of the study are based on 11 children (six boys and five girls, eight from middle-class and three from working-class families). The median age of the children was 5 years, 11 months; the range from 5 years, 5 months to 6 years, 3 months.

Although the sample of children is small, the results on each child are based on many hours of observation carried on over an entire school year, and the categories of analysis are highly reliable.

Criteria for selection of the children were as follows: (*a*) that the home

be intact; (b) that the child be an only or the oldest child, without prior nursery school experience (so that this would be the first school-entry experience of the family); (c) that the family be middle-class or working-class and the home be English speaking.

The children were chosen from two classrooms: six children (three boys and three girls) from a relatively tight, rigid kindergarten that emphasized preparation for first grade; and the remaining five (three boys and two girls) from a relatively free setting with emphasis on play and learning through here-and-now activities. Each of these kindergartens contained 20 to 25 children. These kindergartens as settings have been described in previous publications (5, 6).

1. *Data Collection*

In order to study both the children and the classrooms, four different types of observations were carried out. The findings of the present study are based on one of these types of observation: namely, half-hour nonselective observations of individual children. For the individual child observations, the instructions for the observers were as follows: The observer's main function was to follow one study child for a half-hour in order to obtain complete picture of this child and his life space for this time. The specific focus was on the child's way of relating to people, materials, tasks, and routines with which he was involved. The observers were instructed to note what the child did or failed to do (where a response might normally be expected), what his emotional responses were, and how he interacted with the people and objects in the classroom environment.

These observations were carried out during four different periods during the school year. Observation Period I was from the middle of September through the end of October, Observation Period II during the first three weeks of December, Observation Period III for a total of three weeks preceding and following the spring vacation, and Observation Period IV for a three-week period at the end of the school year.

2. *Data Analysis*

As a first step, the records were subdivided into units. A unit covers a designated school activity from beginning to end; it covers a range of time that is teacher-structured. If the activity was in progress when the record began, the unit begins with the beginning record. Similarly, when the activity continued beyond the end of the half-hour, the unit ends when the record ends. These units cover the various phases of kindergarten life—playground,

organized games, free play, milk time, and rest period. The main purpose of the units was to permit matching, so that the types of activities analyzed were the same from child to child. An average of 17 units were picked for each child, eight from the first observation period and the balance equally distributed among the remaining three observation periods. The 17 units covered an average of five and one-half hours' observation time per child (range, four hours, 18 minutes to seven hours, 28 minutes).

Each unit, as described above, was analyzed to determine the number and kinds of interactions of each study child with every other child with whom he interacted: i.e., who initiated the interaction, what the initiated act was, and what the other child's response was.

A set of categories had already been evolved for the analysis of the total classroom (teacher and group focused) observations (5, 6). These categories were adapted and applied to the individual child observations. The categories fell into five main groups: (a) Structuring—when a child structured for another; (b) Assisting—when a child assisted another; (c) Evaluating—when a child evaluated another child; (d) Stimulating—when a child intellectually stimulated another; and (e) Participation—when a child interacted with another in a more general way.

Each of these main categories was subdivided into a number of subcategories—for example, whether the structuring was domineering or kindly, whether the assistance was done in a domineering or kindly fashion—as well as into items describing acts initiated and responses to initiated acts.

For the present study, only acts initiated were considered, and these were divided into two groups:²

1. *Positive actions*: For example, child directs, leads, controls kindly; child asks for guidance and advice; child assists in a kindly constructive manner; child evaluated another child in a positive way; child extends invitation for interactions to another child; child initiates a new idea or extends the idea of another child, etc.

2. *Negative actions*: For example, child structures in a bossy and domineering way; child helps in a domineering way; child evaluates another child negatively; child acts in a provocative and aggressive manner towards another child; child takes property of another child, etc.

² The categories and their grouping into constructive and destructive items have been deposited as Document number 8906 with the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D. C. A copy may be secured by citing the Document number and by remitting \$1.25 for photoprints, or \$1.25 for 35-mm microfilm. Advance payment is required. Make checks or money orders payable to Chief, Photoduplication Service, Library of Congress.

The interactions in all the units analyzed were counted and two types of measures were calculated for each child:

1. *Rate*: (a) the rate on an hourly basis at which the study child initiated activity towards others, and (b) the rate on an hourly basis at which others initiated activity towards the study child.

2. *Per cent positive*: (a) the per cent of behavior initiated by the study child to others that fell into the positive category, and (b) the per cent of behavior initiated by others towards the study child that fell into the positive category.

The classroom analysis categories from which the present categories were adapted had been subjected to an intensive reliability study. Two scorers independently categorized 2008 incidents, and there was exact agreement in 86 per cent of the instances. Since the refinements made for the individual child analysis were all obliterated by the pooling of the items into two groups (positive and negative), no further item-by-item reliability study was undertaken. However, the children's per cent positive scores during the first two observation periods were correlated with their per cent positive scores during the Observation Periods III and IV. The rank order correlation was .78 ($p < .01$).

C. RESULTS AND DISCUSSION

Tables 1 and 2 present the results of the study. Table 1 presents the data on the 11 study children that comprised the sample; specifically (a) the rate and per cent positive of each study child's initiation towards others, (b) the rate and per cent positive with which others initiated towards the study child, and (c) each study child's rank within the group on these four measures. At the bottom of Table 1, the median scores of the group on these four measures are presented.³

Table 2 presents the Spearman Rank Order Correlations (ρ) among the various measures. In two of the correlations (Numbers 6 and 8), three ranks were tied; these correlation coefficients were corrected for these ties (8).

³ Table 1 shows that the median rate of initiation by the study-children to others was higher than the rate of initiation of others to the study-child. It is very likely that this difference is an artifact of the focus of the observers who may have been more sensitive to picking up all of the study-children's actions towards others than the actions of others towards them. Bott (2) reports a similar discrepancy and offers the same explanation, the fact that the range for both per cent positive and rate of initiation was smaller for the other-to-study-child measure than for the study-child-to-others measures is due to the fact that the scores for the study-child measures are each contributed by one child only, whereas the others-to-study-child measures are contributed by many children; the constriction of range, therefore, represents an averaging of many children.

TABLE 1
STUDY-CHILD INITIATES TO OTHERS AND OTHERS INITIATE TO STUDY-CHILD

Study-child	Study-Child Initiates to Others				Others Initiate to Study-Child			
	Rate	Rank of rate	Per cent positive	Rank of % constructive	Rate	Rank of rate	Per cent positive	Rank of % constructive
A	32.0	1	82	7	17.0	1	75	6.5
B	28.2	2	58	10	11.0	5	65	10.
C	24.2	3	56	11	10.5	6	75	6.5
D	20.0	4	86	6	12.2	4	82	3.5
E	20.2	5	89	5	13.4	3	74	8.5
F	19.7	6	65	9	9.9	7	58	11.
G	17.8	7	96	2	14.7	2	82	3.5
H	17.4	8	81	8	8.3	9	74	8.5
I	13.8	9	94	4	9.8	8	83	2.
J	12.9	10	98	1	7.3	10	81	5.
K	3.7	11	95	3	5.9	11	90	1.
L								
Median	19.7		86		10.5		75	
Range	3.7-32		56-96		5.9-17		58-90	

Three types of results will be discussed: (a) the median scores and their significance; (b) "Within-study-children" correlations (the relationship between rate and per cent positive within the same child as well as the effect of age on rate and per cent positive); and (c) "Between-children" correlations (the relationship between the study-children's rate and per cent positive, and the rate and per cent positive directed towards them by others).

The median per cent of positive acts in the present study was 86 per cent

TABLE 2
"WITHIN-CHILDREN" AND "BETWEEN-CHILDREN" RELATIONSHIPS

Relationships	<i>r</i>	<i>p</i>
<i>"Within-Children" Relationships</i>		
1. Relationship between constructiveness of study-child and rate of initiation by study-child	— .69	< .05
2. Relationship between age of study-child and rate of initiation by study-child	— .26	n.s.
3. Relationship between age of study-child and constructiveness of study-child	— .14	n.s.
<i>"Between-Children" Relationships</i>		
4. Relationship between rate of initiation by study-child and rate of initiation by others to study-child	.77	< .01
5. Relationship between rate of initiation of study-child and constructiveness of other children	— .45	n.s.
6. Relationship between constructiveness of initiation of study-child and rate of initiation to him by others	— .18	n.s.
7. Relationship between constructiveness of study-child and constructiveness of others to him	.68	< .05
8. Relationship between constructiveness of study-child and ratio of rate of others to study-child to rate of study-child to others	.80	< .01

for the study-children to others, and 75 per cent for others to the study-child. Mengert (7), using a friendly-unfriendly dichotomy, found that friendly behavior constituted approximately 80 per cent of the total, roughly similar to the present findings.

1. *"Within-Children" Relationships*

Table 2 shows that within the relatively narrow age range of the children in the study, no significant relationship was found between either per cent positive or rate and the age of the study-child; therefore, none of the results presented below can be accounted for in terms of the age factor.

Table 2 also shows a rank order correlation of —.69 ($p < .05$) between a child's rate of activity and the per cent of the activity that is positive. In other words, in this particular sample, the more active child was also the

less constructive one. These results make sense in terms of our more general knowledge of the children studied. The three children with the highest per cent positive were rather meek and inhibited; they seem to have considerable difficulty expressing any aggression. On the other hand, two of the three children with the highest initiation rate were rather hostile and seemed to be under a great deal of inner pressure to express themselves in domineering and bossy ways. The children whose constructiveness scores were between 80 per cent and 90 per cent seemed to be the best functioning ones. In general, they had a moderate degree of initiation rate, were on balance constructive, but not to the extent that it restricted their self-expression.

2. "Between-Children" Results

Results presented in Table 2 show a high degree of correlation between the rate at which the child initiated acts towards others and the frequency with which they initiated acts towards him ($r = .77, p < .01$). These findings are in line with the previously mentioned results obtained by Bott (2).

There is also a significant correlation between the per cent positive acts a child initiates to others and the proportion of positive acts others initiate towards him ($r = .68, p < .05$). These findings, although based on somewhat different measures than Anderson's, generally express the same type of relationship and indicate that the correlations that Anderson found to be true for a relatively brief experimental session also hold for increased time periods.

No significant relationship was found between the proportion of positive acts the study child initiated to others and the rate with which others initiated to him ($r = -.18, n.s.$).

There is, however, an almost significant inverse relationship between the rate with which a study-child initiated to others and their per cent positive score towards him ($r = -.45, n.s.$); in other words, the children who were most active tended to receive somewhat more negative contacts from others. This finding may be due, in part, to the previously reported results which showed the more active study-children tended also to have the lower per cent of positive acts.

In order to parcel out this factor, the author tested the assumption that the more constructive in his approach the child is, the more his rate of initiation to others would be matched in a one-to-one way by their rate of initiation to him. In other words, given two children of equal activity rate, the one who had a greater proportion of positive acts should have proportionately more

activity initiated towards him than the one who initiates a low proportion of positive acts. Therefore, per cent positive was correlated with a ratio of the rates of others initiating towards the study-child to the rate at which he initiated towards them. This correlation was highly significant ($r = .80$, $p < .01$).

These results suggest that both with respect to quantity and quality, the child gets what he puts out; that, in other words, the child creates his own environment. Thus, the hostile child is the recipient more frequently of hostile activity from others than is the unhostile child; this then validates his being hostile to begin with. It is quite likely that this is one mechanism through which continuity of personality development is maintained. The child manages to bring about that kind of approach from the world that validates, in a sense, his own approach to it. Basic here is the assumption that through his behavior the child is a causal agent in bringing about a given kind of psychological environment. Alternative explanations, however, are possible: for example, a child may be physically attractive to others, be contacted by them frequently and, in turn, contact them frequently.

An important feature of the present study very likely was the opportunity that the children had to choose among many playmates. A classroom is a setting that offers choice among a wide variety of children—some passive, some active, some with a constructive approach, others with a more destructive approach. The rate and constructiveness of the interactions that a child draws to himself reflect no doubt, in part, his choice of peers from among the children in the classroom. The variety of children available probably offers the individual child sufficient choice to enable him to construct the kind of environment which will keep constant his prevailing mode of adaptation. The mild-mannered, low-initiative child will, in all likelihood, select the nice children who will collaborate with him to maintain his preferred equilibrium between himself and the environment.

D. SUMMARY AND CONCLUSION

The present study examined the extent to which rate and quality of peer activity directed towards a particular child was a function of the rate and quality of acts that the child initiated towards others.

Significant positive correlations were found between (a) the rate at which a child initiated towards others and the rate at which his peers initiated towards him, (b) the proportion of positive acts that he initiated towards others and the proportion of positive acts that they initiated towards him, and (c) the

proportion of positive acts that he initiated towards his peers and the ratio of the rate of others initiating to study-child by rate of study-child initiating towards others.

These findings suggest that in his interaction with his peers, the child manages to evoke from them the kind of behavior that will permit him to maintain his prevailing mode of adaptation.

The findings of this study are based on a small number of children studied over an extensive period of time (one school year). They are highly suggestive, but need to be confirmed with a larger sample.

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SOCIAL REFLEXES NOS. 1 AND 2 IN RELATION TO
APPROACH AND AVOIDANCE TENDENCIES*¹

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A. INTRODUCTION

Murchison (8) introduced the concept of "social physics": i.e., the time and space measurement of social phenomena. In an attempt to derive laws, Murchison concentrated on time and distance relations between pairs of domestic cockerels in a runway. The main law emerging from the early studies related what Murchison called Social Reflex No. 1, the tendency for one *S* to approach the other, and Social Reflex No. 2, the relative "pugnacity" of the *Ss*. Murchison provided empirical verification for the following relationships: "When plotted as a function of Social Reflex No. 2, it was found that Social Reflex No. 1, when plotted in terms of space alone, was almost truly linear" (9, p. 3).

As an extension of this study, King (6) related (a) the frequency with which a dominant fowl pecked a subordinate in the home coop, and (b) the distance maintained by the subordinate when the dominant was fixed in a straight runway. As might be predicted from the Murchison study, the distance maintained by the free-moving subordinate from the fixed dominant was linearly related to the frequency with which the latter pecked the former in the home coop.

Taken together, these findings of Murchison and King suggest that some features of "social physics" coordinate with certain aspects of behavior theory. In particular, it would seem that the basic paradigm underlying the "social reflexes" of a subordinate in relation to a dominant *S* may be that of approach-avoidance conflict. While the behavior of a subordinate to a dominant *S* constitutes only one aspect of "social physics," it is an important aspect, since in theory all but the alpha member of a hierarchy is subordinate to at least one other member. In the present study, then, theoretical analogies were drawn between the "social reflexes" of subordinate fowl in relation to dominants on

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the one hand, and approach and avoidance tendencies on the other. Empirical verification of these analogies was sought.

In the first place, the outcome of Social Reflex No. 1 and the approach tendency in Miller's paradigm (7, p. 205) would appear similar. However, Social Reflex No. 1 may or may not be based on the primary characteristics of adience as outlined by Brown (1). One animal may approach a like species member to engage in combat, or on the basis of some positive social reinforcer or reflex tendency [cf. Schneirla (11)]. However, since the present project is primarily concerned with the approach of a subordinate *S* to a dominant, the likelihood of approach for agonistic purposes is extremely remote. But the fact that the *S* is a subordinate raises an interesting question. In most vertebrates, dominant-subordinate relationships between pairs arise out of initial encounters [see Schjelderup-Ebbe (10)]. It might be expected from Murchison's study (8) that these initial encounters would affect the approach of the loser to the victor, and this was empirically determined in the present study.

A covariance design was used to correct for any effect that the dominance encounter had on the approach tendency, and further measurements were taken to ensure whether or not the tendency took the form of an approach gradient as defined by Brown (1), and Trapold, Miller, and Coons (13). No attempt was made in the present study to determine whether the approach gradient arose initially from a reflex tendency or a positive social reinforcer; emphasis was placed on the measurement of the tendency.

The remaining research hypothesis concerned avoidance tendencies. The behavior of subordinate *S*s in the Murchison (8) and King (6) studies suggests that the frequency of noxious stimulation received by a subordinate modifies the approach tendency. In the present study, subordinate *S*s received different levels of noxious stimulation in the presence of a superior *S* to determine whether, and to what extent, the approach tendency was modified.

B. METHOD

Thirty-five domestic hens, aged about 18 months, were drawn from a control breeding flock at the Veterinary School Farm, University of Queensland. For one month prior to experimentation, one *S* was housed in every second compartment of a commercial laying battery. This prevented any *S* from intimidating any other, and according to Guhl (4) would allow sufficient time for extinction of any existing dominance relations.

1. *Conditioning Apparatus*

This was a white painted box (three feet, six inches long, two feet, six inches high, and one foot, six inches deep) with a guillotine door across the

center and a one-way screen across the front. The interior was lighted by a 40-watt fluorescent tube.

2. Alleyway

This was 22 feet long, two feet, six inches wide, and three feet, six inches high, with walls and roof covered by hessian. The floor area was covered by five grey-painted pressure plates, each four feet by two feet, six inches, except for a section at one end (two feet by two feet, six inches) where the conditioned stimulus (CS) was to be fixed. These floor plates were sprung so that the weight of an *S* (four pounds average) on any one panel started off a clock that automatically stopped when *S* moved on to the adjacent panel. The interior was lighted by five 40-watt fluorescent tubes set in the roof.

3. Treatments

Each treatment condition was in four parts: (a) determination of dominance relationships, (b) determination of approach tendency, (c) interanimal aversive conditioning, and (d) redetermination of approach tendency.

Ss were randomly designated to groups of five. In each group one *S* was to act as CS; the remainder were randomly allocated to zero, 10, 20, or 30 shock conditions.

Five days prior to stage *a*, platinum electrodes were implanted in the comb of each *S*. In the two days leading up to the first treatment, Ss had six 20-minute sessions alone in the alleyway for familiarization.

a. Determination of dominance relationships. The development of group structure in domestic hens usually falls into two parts. First, strange Ss upon initial meeting determine dominance relationships. Once established, these relationships are very reliable, and form the basis of the pecking order. Second, only after the dominance relationships have been established does regular interanimal pecking emerge; this is usually one-way, from the dominant to the subordinate of each pair. In an independent pilot study, it was found that aversive conditioning of a naturally dominant *S* to a subordinate CS produced irregular effects: e.g., dominance fighting in the conditioning box. These results are coordinate with those reported by Smith and Hale (12). Thus, although a dominance encounter had to be permitted before experimental aversive conditioning, the effect due to these initial encounters was removed statistically as the initial approach tendencies measured in stage *b* were equated by the covariance design.

Collias (2), Guhl (4), Wood-Gush (14), and others list body weight and comb size as indicants of success in dominance fighting. From each group

of five *S*s, the one with the greatest body weight and comb size was paired in the conditioning box against the *S* rated second on these criteria. The winner of this encounter was paired against the third rated *S* and so on until the dominance hierarchy was determined with a minimum number of encounters. Except in one group, each subordinate *S* had to be paired only once. After dominance relationships were established, *S*s were returned to the laying battery.

b. Determination of approach tendency. On the two days subsequent to the dominance encounter, approach to the selected CS—i.e., the alpha bird in each hierarchy of five—was determined. *S*s had two runs per day; for these trials the dominant *S* was secured by the feet at one end of the alleyway and the subordinate *S* released from the opposite end. Each *S* remained in the alleyway for 20 minutes, and the time spent on each panel was automatically recorded on the clocks.

c. Interanimal aversive conditioning. Each *S* and the corresponding CS were placed in the adjoining compartments of the conditioning box with the guillotine door in place. Five minutes were allowed for *S*s to settle, at the end of which time both *S* and CS were secured in a restraining harness and light, sprung wires were attached to the platinum electrodes previously implanted in the comb of *S*. The subsequent five minutes were allowed for *S* and CS to settle, at the end of which conditioning began.

Shocks were delivered from a condenser discharge stimulator through the platinum electrodes in the comb of *S*. It was found that this method gave very low interanimal variability in resistance ($M_{\Omega} = 7.5 \pm .5K$), and that *S*s reacted in much the same way as they normally do to pecking. Subjects received approximately 75 volts for one-half second with shocks being administered in blocks of five; on the minute, the door slid down silently revealing the CS, and five shocks were administered at 10-second intervals. On the subsequent minute, the door slid up again and remained closed for one minute. *S*s on the 10-shock schedule received two blocks of five shocks; *S*s on the 20-shock schedule received four blocks, and so on. After the last conditioning trial, the door remained closed for five minutes. At the end of this time, *S* was removed to an isolation cage for one hour, during which time feed and water were available.

d. Redetermination of approach tendency. After one hour in the isolation cage, *S* was returned to the alleyway with the CS at the far end. Approach during 20 minutes was again recorded on the clocks in the same way as on the previous day, prior to conditioning.

4. Control Conditions

In the present design, a control condition (no shocks) was included to ensure that the modification of approach resulted from the treatments.

Since the treatments involve shock, a second control group should be included to check on the possibility of response suppression due to shock in the experimental context. S should be shocked in the presence of an S other than the intended CS. However, generalization from the substitute S (conditioning) to the testing S (alleyway) interferes with this treatment.

As an alternative the initial response latency in the alleyway—i.e., the time taken by S to move its foot initially towards the CS—was taken before and after conditioning. It follows from the Miller paradigm that the avoidance gradient should not initially influence the approach gradient because of the greater steepness of the former. On the other hand, had response suppression due to shock been effective then initial latencies should have increased after aversive conditioning.

A covariance test carried out on the differences in initial latencies before and after conditioning did not approach significance at the 5 per cent level, nor was any trend apparent. In view of this, it would seem that the precautions taken against suppression by shock—*viz.*, one hour's rest in an isolation cage with open access to feed and water—obviated any such effect.

C. RESULTS

In a recent study, Trapold *et al.* (13) departed from the usual measures of approach tendency: i.e., strength of pull against restraining harness or running speeds. Instead, they used a 100-foot alleyway divided into segments of equal size and recorded the time spent on each space; "average block" was used as the measure of tendency. The present measure, "average distance," is obtained in the same way that Trapold *et al.* obtained "average block." Let T_{\max} = total time in alleyway; D_i = distance of panel i from the start end; T_i = time spent by S on panel i ; and n = number of panels. Then for any S :

$$\text{Average Distance} = \frac{\sum_{i=1}^n (T_i \cdot D_i)}{T_{\max}}.$$

An analysis of covariance (see Table 1) was carried out on the "average distances" with differences in initial approach scores being used to correct the scores subsequent to conditioning.

From Table 1 it can be seen that the effect due to aversive conditioning—i.e., zero, 10, 20, or 30 shocks—was highly significant ($F_{3,17} = 5.18$ at the 1 per cent level). On the other hand, the effect due to use of different CSs from group to group did not approach significance ($F_{6,17} = 2.70$ at the 5 per cent level). The corrected treatment means—i.e., suppression of the initial approach tendency due to conditioning—were 30 shocks = 10.9 feet, 20 shocks = 6.6 feet, 10 shocks = 2.9 feet, and no shocks = zero feet. This trend is almost truly linear and the best fitting straight line is as follows: suppression due to conditioning equals .36 frequency of noxious stimulation minus .04 foot. A Duncan Multiple Range Test (3) was carried out on the corrected means.

TABLE 1
ANALYSIS OF COVARIANCE ON MEAN DISTANCES OF SUBORDINATE TO DOMINANT SUBJECTS
UNDER FOUR LEVELS OF INTERANIMAL CONDITIONING

Source of variation	Sums of squares of errors of est.	df	Var. est.	F
Groups	38.67	6	6.45	1.59
Treatments	456.40	3	152.13	37.56
Error	68.94	17	4.05	

D. DISCUSSION

It was apparent from the results that, *after* initial dominance encounters and before aversive conditioning, Ss approached the dominant S but to varying degrees—over all groups, the mean distance traversed up the alleyway was 14.5 ± 3.8 feet. This bears out the research hypothesis that approach tendencies to same species members exist even after the initial dominance encounter. The mean distances before conditioning, reported in Table 1, for the most part coordinate with approach gradients as reported by Trapold *et al.* (13).

In all except the control group (no shocks), the initial approach tendency was modified by interanimal aversive conditioning. Some gaps between the adjusted means were significant on the Duncan Multiple Range Test; in all cases the effect was to shift the locus of the initial mean distance away from the CS, which indicates that approach-avoidance is congruent with studies on "social physics." The results are comparable to those obtained by King (6), although no conclusions about approach-avoidance could be made from the latter study.

The regression of mean distance due to conditioning on shock frequency shows that the suppression of the initial approach tendency was almost truly

linear within the range studied. This finding is compatible with that of Murchison (8) in his study of "social physics."

E. SUMMARY

Interanimal aversive conditioning was used to modify the approach tendencies of one domestic fowl to another. It was shown that the extent to which the initial approach tendency was modified was a linear function of the frequency of noxious stimulation that the approaching *S* received in the presence of the CS.

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INTERPERSONAL RELATIONS IN PRESCHOOL CHILDREN AND AVERAGE APPROACH DISTANCE*¹

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A. INTRODUCTION

Following on from Murchison's series of experiments on "social physics" (5, 6), King (2) showed that subordinate members in flocks of fowl maintained characteristic distances from more dominant members and that these average approach distances were related to the frequency of noxious stimulation that the subordinate members received from the more dominant members. King went on to show that these characteristic approach distances reduced to zero when a food source was juxtaposed with the more dominant member.

A subsequent study by King (3) related the behavior pattern outlined above to approach and avoidance tendencies. In particular the situation represented by a more dominant *S* to a subordinate *S* was shown to fit Miller's approach-avoidance conflict paradigm (4).

The present study was carried out for two main reasons. First, it was hypothesized that if responses between young children could be limited to simple approach and avoidance tendencies, then results comparable to those obtained by King (2) might also be obtained at the human level. The second reason derived from the different type of dominance relationship prevailing in children's groups. In most strains of domestic fowl, the dominance relationship fits what Allee (1) calls "peck right": i.e., the more dominant of each pair noxiously stimulates the less dominant, but the latter rarely, if ever, retaliates. This type of relationship is contrasted with a "peck-dominance" relationship: i.e., both the more and the less dominant of each pair may noxiously stimulate each other, but the former usually wins out.

Apart from the question of whether or not approach distances may be demonstrated in preschool children, the existence of a "peck-dominance" type of relationship poses some interesting questions that do not arise with the "peck-right" relationships.

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Accordingly, the present project was designed to probe some of these questions. Since the subordinate in a "peck-dominance" relationship may noxiously stimulate the dominant, does the dominant maintain some characteristic distance to the subordinate? On the other hand, since the subordinate may noxiously stimulate the dominant *S*, would this make it more likely for the subordinate to approach closer to the dominant?

B. METHOD

1. Subjects

From a kindergarten center with 180 children between 3 and 5 years in chronological age, a sample of 36 *Ss* was drawn at random and allocated without replacement to triads. The following restrictions were placed on the formation of the triads: (*a*) each triad contained children of the same sex, (*b*) chronological ages within triads differed by no more than six months, and (*c*) all *Ss* had attended the kindergarten center for at least six months prior to experimentation. Six of the experimental triads were composed of males and six of females.

2. Procedure

This was the same for each experimental triad and consisted of (*a*) Stage 1: appraisal of friendly and unfriendly acts made by each member to each other member during free play, and (*b*) Stage 2: subsequent determination of average approach distances between pairs of children making up each triad.

a. Stage 1. Each experimental triad was observed for 30 minutes in free play in an observation room. This was a small room wired for sound and fitted with a one-way screen. In it a small table was placed centrally with three chairs around it. For the groups of boys three toy automobiles were provided, while the girls each had a doll.

During the free-play session, interactions were observed by three experimenters, who were either graduate students or staff members of the Department of Psychology, University of Queensland. If any *S* directed what was judged to be a friendly act or vocalization towards another member, this was scored as a positive point for the *S* making the act; if the act or vocalization was judged as unfriendly the performer received a negative point.

At the conclusion of each observation session, each *E* had recorded the number of friendly and unfriendly acts made by each *S* to each of the other two members of the triad.

b. Stage 2. Approach distances were measured between pairs of *Ss* in a sandpit, 20 feet long, four feet, six inches wide and with sides six feet high.

The walls of the sandpit were decorated with cartoon figures. Sand was spread evenly on the floor to a depth of about six inches and was levelled after each testing. A movie camera, geared to fire once every 30 seconds, was mounted over the center of the sandpit at a height of 25 feet.

Ss were taken two at a time from the observation room to the sandpit, while the third remained with the teacher. One S was privately instructed to remain at one end, while the other S was free to move anywhere in the sandpit. In order that responses might be confined to simple approach and avoidance tendencies between S s in the test situation, communication had to be restricted in the alleyway. In a pilot group, the following instructions proved effective (but two triads in the experimental groups had to be rejected because of extensive communication). Let S_1 , S_2 , and S_3 represent the members of a triad (the subscript is not meant to designate position in a hierarchy). Consider the pair S_1 and S_2 where S_1 designates the collaborator. S_1 was placed at one end of the sandpit and told:

We are going to play a game on S_2 . If you stay right up this end I will give you a lolly (i.e., a sweet or candy) at the end of the game, but you must keep it a secret from S_2 . Here is a bucket and spade—now you can build some sand castles.

Simultaneously, a second E placed S_2 at the opposite end of the sandpit and said, "Here is a bucket and spade—now you can build some sand castles." At this juncture E s withdrew and the camera started. After seven minutes, E returned and placed a rocking horse at the collaborator's end of the alleyway and said, " S_1 and S_2 , look what I've got for you to play with." E again withdrew and filming continued for a further three minutes. S_1 and S_2 were then taken from the sandpit.

Subsequently S_2 and S_3 were filmed, using the same procedure as outlined for S_1 and S_2 , but with S_2 acting as collaborator. For the filming of S_1 (collaborator) and S_3 , the ends were reversed to counter any tendency S_3 might have acquired on the previous trial.

For other triads the sequences S_1 - S_2 , S_1 - S_3 , S_2 - S_3 , and S_1 - S_3 , S_1 - S_2 , S_2 - S_3 (where the first of each pair denotes the collaborator) were also randomly used. Other possible sequences could not be employed, since they require the use of an S subsequent to sophistication as a collaborator.

C. RESULTS

During the free-play session, each E judged the frequency of friendly and unfriendly acts made by each S to each other S in the triad. It was found that observers disagreed on the frequency of acts but agreed on the ratio of

friendly and unfriendly acts. Disagreement over the frequencies probably resulted from the fact that observers had to sample acts as they occurred rapidly in many of the groups.

In view of this, the interaction ratio for each S to each other S was cal-

TABLE 1
MEAN INTERACTION RATIOS OF COLLABORATORS AND SUBJECTS IN EACH TRIAD AND
THE CORRESPONDING MEAN DISTANCES OBSERVED IN THE SANDPIT
BEFORE AND AFTER INTRODUCTION OF THE ROCKING HORSE

Triad	I.R. collab. to S	I.R. S to collab.	Mean distance in feet without horse	Mean distance in feet with horse
1	.17	.00	2.3	2.1
	.44	.50	7.8	1.5
	.50	.29	11.7	3.7
2	.19	.21	6.7	4.3
	.26	.25	9.3	1.8
	.33	.00	7.3	5.0
3	.94	.56	17.8	18.2
	.84	.58	16.0	7.1
	.76	.65	13.2	2.6
4	.31	.30	11.6	6.8
	.50	.50	camera failed	5.7
	.50	.50	8.3	camera failed
5	.04	.05	2.0	3.7
	.00	.29	2.9	12.2
	.22	.47	3.8	3.4
6	.43	.21	15.9	12.5
	.34	.27	8.3	3.2
	.38	.37	12.9	2.8
7	.67	.30	8.6	4.8
	.83	.67	10.2	5.8
	.81	.55	8.1	1.8
8	.43	.40	16.9	3.5
	.37	.50	13.3	1.3
	.36	.44	11.1	3.3
9	.43	.27	3.8	4.6
	.21	.80	4.1	6.3
	.58	.38	17.1	3.8
10	.00	.00	2.6	2.9
	.74	.36	10.9	3.1
	.50	.56	7.0	3.8

culated. For example, the interaction ratio (I.R.) of S_1 to S_2 was the ratio of unfriendly acts to the sum of friendly and unfriendly acts made by S_1 to S_2 ; interaction ratio equals frequency of unfriendly acts divided by total number of acts. For S_1 , then, each observer had estimated two I.R.s, S_1 - S_2 and S_1 - S_3 , and this applied to each member of each triad.

Comparison of corresponding I.R.s for each observer showed that *Es* agreed highly; Kendall's "*W*" coefficient was calculated to check on the reliability of observers' estimates of each I.R. In the experimental triads, the "Coefficient of Concordance" was significant at the 1 per cent level of confidence for eight of the groups and at the 5 per cent level for the remaining two triads. In view of this, the mean value of all observers' estimates of each I.R. was taken. For example, assume that Observer 1 estimated the I.R. of S_1 to S_2 to be x_1 , Observer 2 estimated x_2 , and Observer 3 estimated x_3 ; then the mean I.R. of S_1 to S_2 was the mean of x_1 , x_2 and x_3 .

In Table 1 mean I.R.s are given. The left-hand score is the I.R. of the collaborator to the *S*. The score next to that on the right is the complementary I.R. of that *S* to the particular collaborator.

Distances between each pair of *Ss* in the sandpit were obtained by reading off the distances between *Ss*' heads on enlarged negatives. Since the camera fired every 30 seconds, mean distance is given by the following formula:

$$\text{Mean Distance} = \frac{\sum_{i=1}^N D_i}{N},$$

where D_i = physical distance between collaborator and *S* on frame i , and N = number of frames taken.

On the right-hand side of Table 1, two mean distances are given for each pair tested—the extreme right-hand score being the distance maintained after the rocking horse was introduced into the alleyway. The score next to that on the left is the distance maintained by *S* before the rocking horse was introduced.

D. DISCUSSION

Several important relationships emerge from Table 1 and these are presented as *tau* coefficients (7). Since both I.R.s and mean distances occur within subgroups, the treatment follows a method outlined by Torgerson (8) wherein *tau* coefficients for subgroups are pooled and the overall significance determined.

In the first place, there appears to be very little relationship, taken over all subgroups, between the I.R. of collaborator to *S* and the complementary I.R. of *S* to collaborator. The pooled *tau* between these two sets of I.R.s was $-.04$, $p > .05$. This lack of statistical relationship does not coordinate with either an aggression-aggression or an aggression-suppression hypothesis between pairs of children interacting in triads. However, there does appear to be con-

siderable variation between subgroups in this respect, which calls for further investigation.

The correlation was determined between (a) the I.R. of collaborator to *S* (in the observation room), and (b) the corresponding mean distance maintained by *S* from the collaborator (in the sandpit). This relationship indicates whether the interactions occurring between members in children's groups influence the spatio-temporal relationships outside the group situation. The value of the pooled *tau* was .74, $p < .01$.

Further, the correlation was determined between (a) the I.R. of *S* to the collaborator (in the observation room), and (b) the corresponding mean distance maintained by *S* from the collaborator (in the sandpit). The value of the pooled *tau* was .11, $p > .05$.

These correlations indicate that the I.R. of collaborator to *S*, as compared to the I.R. of *S* to collaborator, played a much larger part in the determinancy of the mean distance of *S* as was suggested in the research hypothesis. Further, it would seem that the I.R. of *S* to the collaborator played a relatively minor part and was not nearly as important as the I.R. of the collaborator to *S*.

Table 1 shows that the I.R.s of some collaborators were equal to or lower than the complementary I.R.s of the *S*, which brings out certain features of the "peck-dominance" type of relationship. However, in view of the error of measurement involved in taking the mean interaction ratio, a collaborator is only regarded as dominant over *S* if his I.R. to the *S* is .1 greater than that of *S* to the collaborator. Using this convention, in 13 of the pair relationships the collaborator was clearly dominant over his *S* in terms of a "peck-dominance" relationship. In the remaining 17 cases the collaborator was not dominant over *S*. Thus a comparison can be made between collaborators whose I.R.s were distinctly greater than those of their *S*s and those whose I.R.s were not. Taken over all cases, the relationship between I.R. of collaborator to *S* on the one hand, and mean distance maintained by *S* on the other, appears to be rectilinear. However, where the collaborator was not clearly dominant over *S*—i.e., for cases where the collaborator's I.R. was approximately equal to or less than that of *S*—the regression shows a curvilinear trend. But this may be artifactual, as there are no instances in Table 1 of I.R.s greater than .5 where a collaborator is not clearly dominant over *S*. Clearly, further studies need to be carried out to include high dominant collaborators with high dominant subjects, as information on this is lacking in the present study.

In the second part of this experiment, a rocking horse was juxtaposed with the collaborator in the alleyway. This was intended to parallel an earlier study by King (2) in which characteristic distances maintained by subordinate from dominant fowls were shown to reduce to zero when a food source was juxta-

posed with the dominant *S* in a test alleyway. In the present study it is possible to compare mean distances before and after the introduction of the rocking horse. Correlations were calculated between (a) the I.R. of collaborator to *S* (in the observation room), and (b) the mean distance of *S* to collaborator and rocking horse (in the sandpit). The pooled *tau* was .14, $p > .05$. The correlation was also calculated between (a) the I.R. of *S* to collaborator (in the observation room), and (b) the mean distance of *S* to collaborator and rocking horse (in the alleyway). The pooled *tau* was $-.33$, $.01 < p < .05$.

Consider these correlations in relation to Table 1; the differences in correlation must arise from changes in mean distances as the same I.R.s are considered in both cases. Table 1 shows that for most *S*s juxtaposition of the rocking horse had the effect of reducing mean distances: i.e., it generally brought the locus of *S* closer to the composite goal. In the study by King (2), juxtaposition of a food trough with the dominant fowl invariably reduced minimal distances to zero. For most *S*s this is consonant with the present results, in as much as most mean distances reduced. However, as Table 1 indicates, the reduction in distances was not as consistent or drastic as shown by King.

Introduction of the rocking horse was associated with two important changes in the level of correlation. In the first place, the pooled *tau* between I.R. of collaborator to *S* and mean distance fell from .74, $p < .01$ to .14, $p > .05$. Consequently, the pooled *tau* between I.R. of *S* to collaborator and mean distance rose from .11, $p > .05$ to $-.33$, $.01 < p < .05$, a significant change in the opposite direction. In this connection Table 1 reveals a general tendency for *S*s to approach much closer to the composite goal after the introduction of the rocking horse. But four *S*s moved in the opposite direction, while four other *S*s were hardly influenced by the second treatment. Examination of the I.R.s for these discrepant *S*s revealed that such effects cannot be ascribed to cases where the I.R. of collaborator to *S* was high and the corresponding I.R. of *S* to collaborator was low.

It appears that the significant negative correlation between I.R. of *S* to collaborator and mean distance ($tau = -.33$) arose from a tendency on the part of low dominant *S*s to approach closer to the composite goal than would be predicted. It is suggested that such effects arise from the greater likelihood of deprivation encountered by low dominant *S*s in competitive situations.

E. SUMMARY

An experiment was designed to investigate the effect that friendly and unfriendly interactions occurring in small groups of kindergarten children had

on their spatio-temporal relationships. In particular the ratio of unfriendly acts to the total number of acts made by an *S* to another *S* during free play was strongly related to the mean distance maintained by the second *S* from the first. The mean distances, however, were found to reduce in most cases when a prized toy was juxtaposed with the first *S*.

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AGE AND SEX DIFFERENCES IN CONSCIENCE DEVELOPMENT*

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Two predictions were tested in a partial replication of the early Hartshorne and May study (3): (a) there is a positive relation between age and resistance to temptation; and (b) girls will show less resistance than boys to temptation on a task that is more culturally approved for girls than for boys, while boys will show less resistance than girls on a masculine-appropriate task.

All children in one third-grade ($N = 22$) and one sixth-grade ($N = 26$) classroom of a suburban school district were tested.

The two behavioral measures of conscience development were the ray-gun game developed by Grinder (1) and a book list consisting of 34 book titles. The first five titles and then every sixth one were actual books; the others were fictitious. The children were asked to check those they had read.

TABLE 1
PERCENTAGES OF CHILDREN YIELDING TO TEMPTATION BY AGE AND SEX

Measures	(Boys)	Third Grade (Girls)	Sig.	(Boys)	Sixth Grade (Girls)	Sig.
Ray gun	73	64	n.s.	75	35	.05
Book list	82	91	n.s.	25	21	n.s.

Note: Age difference for both sexes significant at .05 level on book list.

The percentages of children yielding to temptation for the two tasks are given in Table 1. The first hypothesis concerning age differences in resistance to temptation received some confirmation except for the boys on the ray gun. The difference between the two age levels was significant for both sexes on the book list. There was no age difference for boys on the ray gun, while for girls the difference was in the expected direction but not statistically significant. The second prediction regarding sex differences in conscience behavior was supported only at the sixth-grade level for the ray gun, although the sex difference at the third-grade level was in the expected direction for both measures.

The findings are in partial agreement with those of Grinder (2), who

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found a significant age difference for girls but not for boys on the ray-gun measure. The fact that significant age differences were found in the present study for both boys and girls on the book list measure strongly suggests that age trends must be interpreted in terms of the measures used. This holds true also for sex differences.

Until a careful analysis of the types of measures used to assess conscience development in children is made, attempts to identify antecedents of conscience behavior appear fruitless, since a child's behavior on a given task will depend in part upon the psychological relevance of that task to him.

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A CRITIQUE OF PIAGET'S THEORY OF THE ONTOGENESIS OF MOTOR BEHAVIOR*

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A. INTRODUCTION

In recent years, Piaget's formulations regarding the ontogenesis of motor behavior during the first 18 months of life have won a wide measure of acceptance from child psychologists everywhere—even from American authors [e.g., Hunt (6) and Flavell (3)] who have hitherto tended to be highly critical of both his theories and his methodology. One of Piaget's basic assumptions about early motor development is that there is functional comparability and developmental continuity between reflex and nonreflex behavioral sequences. For example, he derives more advanced forms of cortically controlled prehension (e.g., primary circular reactions, hand-mouth coordinations, visual-manual coordinations) from the primitive, subcortically regulated grasping reflex via such mechanisms as "generalizing assimilation," "differential assimilation," and "reciprocal assimilation" to the "grasping schema" (9, pp. 89-116). The theoretical difficulty here arises from the paradoxical fact that Piaget of all persons, who ordinarily overelaborates stage differences far beyond his data, appears to ignore the fundamental distinction between reflex and nonreflex activity. As a result, his description and explanation of early motor development obscure basic differences in rate, patterning, and regulation characteristic of these two forms of behavior, as well as the salient generalization that motor development, as it is generally understood, is an outgrowth of nonreflex rather than of reflex activity [see Ausubel (1, p. 206)]. This theoretical difficulty, of course, applies less to such developmental sequences as sucking and visual pursuit movements that are nonreflex in nature from the very beginning than to sequences that are reflex in nature from the very beginning.

Widespread uncritical acceptance in the United States of Piaget's views concerning the ontogenesis of motor behavior is somewhat surprising considering (a) the well-established distinction between reflex and nonreflex (instrumental, voluntary) behavior that has traditionally prevailed both among Amer-

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ican psychologists generally and among American students of early motor development (2, 4, 7, 8, 10), and (b) the widely accepted Skinnerian distinction between respondent and operant behavior.

B. NEONATAL DIFFERENCES

From the very beginning of neonatal life, reflex and nonreflex behavior are distinguishably different. The stimulus-response connections of reflex behavior are more strongly predetermined by genic factors and are more specific and invariable than those of nonreflex behavior. Reflex acts are also elicited by more particular and specifiable stimuli, and are more adaptive and relevant in relation to the stimuli that evoke them than are nonreflex acts; in any case, their adaptiveness is more innately determined than a product of learning. On the other hand, even relatively localized and segmental nonreflex responses (e.g., sucking) can be triggered off by completely irrelevant stimuli; and, conversely, a single stimulus may evoke several irrelevant as well as relevant nonreflex responses. Whereas individuation of reflex activity virtually reaches completion at birth, individuation of nonreflex activity is at best minimal. Most of the integrated behavior displayed by the neonate consists of coordinated reflexes, such as subcortically controlled creeping and swimming movements and the Moro reflex. Thus the general picture of neonatal behavioral organization is epitomized by the striking contrast between the highly developed segmental and coordinated reflexes and the relatively diffuse, amorphous nonreflex responses that have yet to be individuated and coordinated.

Of particular importance is the distinction between spinal and subcortical regulation of reflex activity, on the one hand, and cortical regulation of nonreflex activity, on the other. Neonatal nonreflex behavior is amorphous in character largely because the degree of cortical control and inhibition that is necessary both for precise and directed specific movements on a nonreflex level, as well as for integration of such movements into increasingly complex patterns, has yet to be attained in the postneonatal period. Cortical inhibition in the first six to 12 months of life is even extended to some *reflexes*, especially to those that are intersegmental in nature (e.g., mass reflex, Moro reflex), and that are suggestive of prehensile (grasp reflex) and locomotor (stepping, swimming, and creeping movements) functions. These latter reflexes are eventually replaced by more segmental or restricted reflexes (e.g., plantar, startle) and by voluntary, cortically controlled prehensile and locomotor responses (8). But except for chronological antecedence and superficial resemblance in the kind of behavior involved, the subcortical, reflex stage of these activities bears little relationship to the cortical, voluntary stage that follows.

The latter is not a functional or developmental outgrowth of the former, but merely a later-occurring phenotypically similar activity dependent upon intervening neural maturation (1, p. 211).

Thus, for example, during the first four to six months of postnatal life, the grasp reflex is gradually replaced by volitional grasping that is both less invariable and characterized by conspicuous involvement of the thumb (5). It is legitimate to interpret this developmental trend as an indication both of increased cortical control and of inhibition of a subcortically regulated reflex, especially since the grasp reflex may be reactivated after injury to the premotor area of the cortex.

C. SUBSEQUENT DEVELOPMENT

Once maximal specificity is attained shortly after birth, reflex behavior undergoes relatively little change. Except for the few reflexes that are suppressed by cortical inhibition, the neonate's vast repertoire of reflex behavior remains intact throughout the life-span. From time to time, of course, depending upon particular idiosyncratic experience, conditioning may occur. In contrast, individuation of nonreflex behavior, far from being substantially complete during the neonatal period, is a continuing aspect of motor development, both in the early "phylogenetic" phase dominated by neural maturation and in the later "ontogenetic" stages dominated by practice (1, p. 209). Hence most of the behavioral change subsumed under motor development occurs in the area of nonreflex activity. With increasing age, nonreflex responses become increasingly localized, economical in extent of involvement, and relevant in relation to their eliciting stimuli—but never as specific or invariable as true reflexes.

Postneonatal modifications of reflex and nonreflex behavior also follow widely divergent paths. Modifications of reflex activity (classical conditioning) tend to be relatively unadaptive, rigid, and irrelevant in relation to new stimulus content, depending as they do solely on arbitrary contiguity. Modifications of nonreflex activity, on the other hand, are more relevant, adaptive, and flexible products of instrumental learning in which either reinforcement of the successful variant or cognitive appreciation of means-ends relationships plays significant roles. Neonatal nonreflex behavior, furthermore, is the developmental precursor of intentional or voluntary behavior, whereas reflex behavior *never* acquires intentionality. The latter is stimulus-bound in the sense that it can be initiated only by stimulation, never voluntarily, and is not ordinarily subject to voluntary inhibition.

Finally, Piaget's explanation of motor development in terms of modification

(generalizing, differential, and reciprocal assimilation) of original reflex schemata has a strongly nominalistic flavor. His explanations generate an illusion of accounting for the nature and causes of developmental sequences, whereas actually they mostly rephrase simple descriptive analyses into more abstract and highly idiosyncratic language. "Reciprocal assimilation of prehensile and visual schemata," for example, tells us little about the actual development of eye-hand coordination—either about the developmental mechanisms involved or the principal determining variables.

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COMPARISON OF MOSAIC RESPONSE OF NEGRO AND WHITE PRIMARY-SCHOOL CHILDREN*

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A. LITERATURE

Literature concerning Negro and white intelligence in the primary-school years is rather plentiful (7, 9) and for the most part agrees that the mean *IQ* of Negro school children is lower than that of supposedly matched white children. However, virtually no research appears to be available that compares responses of Negro and white children on projective techniques. There is one recent study in the literature (6) that compares teen-age Negro and white Rorschach responses, but none that compares responses on the Lowenfeld Mosaic, a test which might be expected to be somewhat free of cultural influences (3, 10). The present study offers such a comparison.

B. METHOD

Present data include Mosaic responses of 217 Negro elementary-school children in attendance at the Abraham Lincoln School in New Haven, Connecticut. The Mosaic was administered individually to each child by the writers. Records are available on 30 five-year-olds, 19 five-and-one-half-year-olds, 50 six-year-olds, 40 seven-year-olds, 25 eight-year-olds, 33 nine-year-olds, and 20 ten-year-olds. Responses were compared with Mosaic responses of three groups of white children of the same ages. These white children were examined earlier as part of ongoing Gesell Institute research, with results reported in papers by Ames and Ilg (3, 4), Ames (1), and Ames, Ilg and August (5). Mean *IQ* ratings for the three white groups listed in Table 1 are 118 for New Haven subjects, 110 for Weston subjects, and 105 for North Haven subjects. For Negro Abraham Lincoln subjects mean *IQ* is in the low 90s.

C. RESULTS

1. *Age Trends in Response*

Table 1 shows the distribution of responses of Negro subjects aged 5 to 10 years, and compares these responses with those of white subjects of three

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TABLE 1
ABRAHAM LINCOLN MOSAIC RESPONSES COMPARED WITH NEW HAVEN, WESTON, AND NORTH HAVEN RESPONSES
(Percentage each group each type; sexes combined)

Grade classification of group	5 years				6 years				7 years			
	N. H.	W.	No. H.	Ab. L.	N. H.	W.	No. H.	Ab. L.	N. H.	W.	No. H.	Ab. L.
A. Nonrepresentational without pattern												
Drop or pile	0	0	0	0	0	1	0	0	0	0	0	0
Scatter	1	17	9	37	0	2	2	14	1	3	0	5.5
Prefundamental	0	12	5	8	0	0	5	4	0	2	1	5.5
Slab	9	0	11	5	5	14	16	6	3	9	21	12
Overall	1	0	3	2	2	0	1	0	0	4	3	0
Lining up pieces	0	0	0	11	0	0	0	16	0	0	0	0
All A	11	29	28	63	7	17	24	40	4	18	25	23
B. Nonrepresentational with pattern												
Fundamental	0	8	3	6	0	2	2	2	0	6	4	0
Central design	15	8	9	8	13	20	9	4	13	12	14	12
Design along rim	4	0	0	0	2	0	0	0	0	0	0	0
Fills tray	4	0	2	0	2	0	1	0	11	2	1	3
Separate designs	5	0	0	0	7	3	3	0	6	0	0	0
All B	28	16	14	14	24	25	15	6	30	20	19	15
C. Representational												
Object	51	50	53	20	47	35	47	44	29	40	34	47
Scene	8	4	4	3	22	18	9	6	33	22	18	15
All C	59	54	57	23	69	53	56	50	62	62	52	62
D. Mixed												
	2	1	1	0	0	5	5	4	4	0	4	0

TABLE 1 (continued)

Grade classification of group	8 years				9 years				10 years			
	N. H.	W.	No. H.	Ab. L.	N. H.	W.	No. H.	Ab. L.	N. H.	W.	No. H.	Ab. L.
A. Nonrepresentational without pattern												
Drop or pile	0	0	0	0	0	5	0	0	0	0	0	0
Scatter	0	0	0	0	0	0	0	0	0	4	0	0
Prefundamental	0	0	0	0	0	0	0	0	0	0	0	0
Slab	9	10	12	8	11	18	8	9	10	15	6	10
Overall	2	0	1	0	1	0	0	0	1	0	0	0
Lining up pieces	0	0	0	0	0	0	0	0	0	0	0	0
All A	11	10	13	8	12	23	8	9	11	19	6	10
B. Nonrepresentational with pattern												
Fundamental	2	0	4	0	0	0	3	3	0	4	0	10
Central design	13	12	11	24	18	5	19	12	14	8	15	5
Design along rim	0	0	1	0	4	0	0	0	0	0	0	0
Fills tray	11	0	2	0	8	5	2	0	12	4	1	5
Separate designs	1	0	2	8	2	0	4	0	4	0	2	0
All B	27	12	20	32	32	10	28	15	30	16	18	20
C. Representational												
Object	34	45	53	48	35	40	48	54	30	46	49	65
Scene	25	28	11	12	20	27	14	12	27	19	26	5
All C	59	73	64	60	55	67	62	66	57	65	75	70
D. Mixed	3	5	3	0	1	0	2	10	2	0	1	0

different intellectual and socioeconomic groups—North Haven subjects who more or less approximate present Negro subjects as to *IQ* and socioeconomic status (SES), and Weston and New Haven subjects of a clearly increased intellectual and socioeconomic status.

The most important thing that this table shows is that behavior in response to the Mosaic test develops in roughly the same way for all four groups of children. For all groups, nonrepresentational products without pattern decrease with age, whereas more mature types of product (nonrepresentational with pattern and representational) increase.

However, though products of Negro children develop in the same direction as do those of white children, they develop more slowly. That is, at both 5 and 6 years of age, products of Negro subjects are clearly less mature than those of *any* white group tested. Nonrepresentational products without pattern predominate in Negro subjects at 5 years of age and occur conspicuously at 6 years of age. In fact 37 per cent of Negro subjects at 5 years merely scatter the Mosaic chips onto the paper, a behavior seldom seen in white children after 3 years of age.

At 7 years and thereafter, products of Negro children compare well with those of North Haven white children who approximate them in *IQ* and SES, and compare favorably with responses of other white groups.

Thus at 8 years of age, figures for Abraham Lincoln Negro subjects are not too dissimilar from those of New Haven white subjects, at least so far as classification of type of product is concerned. Quality of product appears to be rather closely related to intelligence of subjects, and both New Haven and Weston subjects considerably exceed North Haven and Abraham Lincoln subjects so far as quality is concerned.

2. *Mosaic Responses as Indicative of Readiness for Kindergarten*

An earlier study (1) has shown that the Mosaic test is useful in predicting school readiness. Subjects judged ready for kindergarten and for first grade on the basis of Gesell School Readiness tests (8) also produced better or more mature Mosaic responses than did subjects judged questionably ready or unready on the basis of usual readiness tests.

Present 5-year-old kindergarten subjects plus 24 further kindergarten subjects of the wrong age to be included in normative tables—all Negro children from the Abraham Lincoln School—were divided into four groups, $4\frac{1}{2}$ B, $4\frac{1}{2}$ A, 5B, and 5A, on the basis of their responses to Gesell School Readiness tests. Subjects who were less mature than the average 5-year-old and thus judged not ready for a full kindergarten experience were rated $4\frac{1}{2}$ —

4½B if of modest endowment, and 4½A if of higher endowment. Children judged ready for a full kindergarten experience were rated as 5-5B if of modest endowment, and 5A if of good endowment.

Mean chronological age for children of these four groups was as follows: 4½B, 61 months; 4½A, 63 months; 5B, 65 months; and 5A, 65 months.

Mosaic products of these four groups were tabulated. Table 2 gives results. As the table shows, the Mosaic discriminates quite clearly among the four

TABLE 2
MOSAIC RESPONSES OF QUESTIONABLY READY AND FULLY READY KINDERGARTEN CHILDREN
(Percentages of responses)

Grade classification of group	4½B (N = 17)	4½A (N = 17)	5B (N = 5)	5A (N = 15)
A. Nonrepresentational without pattern				
Drop or pile	0	0	0	0
Scatter	70	22	27	0
Prefundamental	6	6	13	0
Slab	0	12	0	20
Overall pattern	6	0	0	0
Lining up pieces	6	6	27	0
All A	88	46	67	20
B. Nonrepresentational with pattern				
Fundamental	0	12	0	20
Central design	0	18	0	20
Design along rim	0	0	0	0
All B	0	30	0	40
C. Representational				
Object	6	18	33	40
Scene	6	6	0	0
All C	12	24	33	40

Note: These percentages when totalled and averaged do not entirely agree with figures for the 5-year-old in Table 1 because a few children included in this present classification were too young or too old for normative grouping.

groups of 5-year-olds. The poorest, or most immature, Mosaic performance (a high predominance of nonrepresentational products without pattern), is given by children in Group 4½B, who make 88 per cent of this most immature type of product. In fact, 70 per cent of 4½B children merely scatter the Mosaic chips, a performance characteristic of 2- to 3-year-old white children.

In the 4½A group, also, the largest single number of children (22 per cent) merely scatter pieces, and 46 per cent make merely some kind of nonrepresentational products without pattern. In the 5B group, nonrepresentational products without pattern still lead as a class, 67 per cent of subjects making such

products. Only in the 5A group do nonrepresentational unpatterned products largely drop out (only 20 per cent) and subjects make either objects (40 per cent) or nonrepresentational products with pattern (40 per cent).

Clearly, by far the best performance is turned out by the 5A group of children, who perform in a manner very creditable for 5-year-olds.

Thus it appears that the Mosaic is a very useful instrument for distinguishing ready and nonready prospective kindergarten subjects and is also useful for grouping students once they have been accepted for kindergarten.

D. DISCUSSION

Further research with this same group of subjects, using a variety of behavior and projective tests (4), suggests that, like most children, individual Negro children perform much better on some tests than on others. Also, Negroes as a group seem to show up better on some tests than on others.

A companion paper to this one (2) shows that the Rorschach response of the Negro Abraham Lincoln child is poorer than that of any white group with which it has been compared. That is, the Negro child is less productive, less imaginative, less creative, and more restricted than is the white child in his response to the Rorschach blots. Furthermore, in the years from 5 to 10, the response of the Negro child is most like that of the white child at 5 years of age and the discrepancy increases in the years that follow.

The Mosaic response of the Negro child is in encouraging contrast. At 5 and 6 years of age the discrepancy between his response and that of the same-age white child is much greater than in the years that immediately follow (see Table 1).

According to Lowenfeld, the Rorschach gives an indication of the way in which the child experiences, while the Mosaic tells how he functions. Thus a child of low intelligence or of low SES may give evidence on the Rorschach of a more or less impoverished psyche but may give evidence on the Mosaic that, in spite of this fact, he can *function* creditably.

The contrast in performance of the Negro child on these two projective tests suggests the importance of testing him on a wide variety of tests in order to discover his true abilities and to determine in which areas of intellectual activity he functions creditably, as well as to discover those in which he may, at present, perform less well than does the white child.

E. SUMMARY

Comparison of the Mosaic response of 217 Negro elementary-school children with products of several groups of same-age white children reveals that the

product of the 5- and 6-year-old Negro is considerably less mature than that of the same-age white child. However, the discrepancy in performance decreases at later ages. This is in contrast to the Rorschach response that in the Negro at all ages from 5 to 10 is less adequate than that of the white child but most closely resembles it at 5 years of age, becoming increasingly less adequate in the years that follow. The conspicuous difference in response to these two tests—the Mosaic response improving markedly with age, the Rorschach failing to do so—suggests the importance of testing the Negro child on a wide variety of tests.

The Mosaic test also shows itself to be a useful instrument for distinguishing ready and nonready prospective kindergarten subjects and for grouping students once they have been accepted for kindergarten.

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SHUTTLE AVOIDANCE: AN APPARATUS FOR CATS UTILIZING AN AIR-BLAST UNCONDITIONED STIMULUS*¹

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A. INTRODUCTION

The shuttle-avoidance apparatus has become a widely used tool in various psychological, electrophysiological, and lesion experiments. Electric shock has persisted as the unconditioned stimulus (US), however, despite documented unreliability (1) and long periods required to train subjects to high performance levels (4, 6, 10). In addition, few investigations to determine aversive stimuli for a given species have been undertaken (11) and it is not known which stimuli will sustain avoidance behavior in a given species.

Air blast, which has seen limited use as an aversive agent (7, 8, 9), is, unlike electric shock, highly directional. When applied from the end of an apparatus, as in this study, the air blast predisposes horizontal movement of the subject. However, when discharged into a chamber of large area, the air blast is unlikely to be aversive unless the subject is either close to the source or cannot sidestep the airstream. Thus, reduction of the air-blast-apparatus area is necessary to present the blast effectively. This constraint has the additional benefit of insuring that the subject will be in the same relative position from trial to trial. By making the apparatus narrow, motor responses that compete with the desired shuttling activity are largely eliminated, and movement is primarily confined to the relevant horizontal dimension.

B. APPARATUS

Several apparatus shapes were tested and it was found that an apparatus 15 inches high, 42 inches long, and narrower in the center (seven and one-half inches) than at the ends (11 inches) was effective (see Figure 1). This shape enabled even large cats to turn around comfortably, increased the directionality of motor activity, and allowed a 20 per cent reduction of apparatus area relative to a rectangular box. Moreover, this shape controlled the direction

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¹ This research was conducted while the author was a United States Public Health Trainee in the Center for Brain Research at the University of Rochester.

the cat faced while sitting—all *Ss* consistently faced the hurdle. The conditioned stimulus (CS) source (75-db buzzer) may be placed in the center of the ceiling over the hurdle or at both ends of the apparatus. Both positions were used here, although since this work was carried out evidence suggesting that end placement is preferable to ceiling placement has been reported (6). Standard shower heads (Sears Catalogue No. 2075) provide effective air-streams. A vertical slot cut into the end wall of each compartment will allow the nozzles to be adjusted at any height from the apparatus floor. Both the

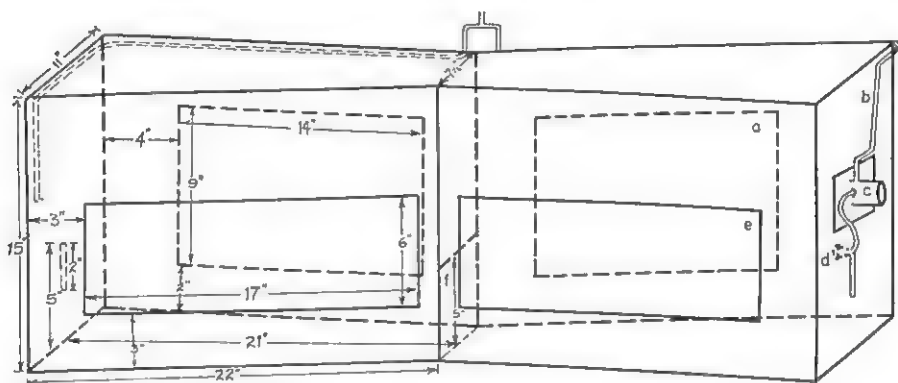


FIGURE 1

SHUTTLEBOX FOR USE WITH AIR BLAST

Although the two compartments are identical, accessories are shown in only one. Letters in the figure indicate (a) rear door, (b) copper tubing, (c) solenoid valve, (d) shower head, (e) window, and (f) hurdle.

Plexiglas windows and the doors may be any convenient dimension. Each apparatus was constructed of three-quarter-inch stock (plywood or flakeboard) and was readily transportable. The joints were caulked, the walls painted light gray, and the bottom fitted with one-half-inch hardware cloth.

In most laboratories, a source of regulated, pressurized air above 30 pounds per square inch (p.s.i.) working load (air flowing through one open solenoid valve) is usually present. If it is not, either a cylinder of compressed air or a small compressor is more than adequate, and commonly available. If the cylinder is used, a reduction valve is also required. To prepare the apparatus for air delivery the air source is connected, via one-quarter-inch inside diameter copper tubing or air hose, to each of the normally closed solenoid delivery valves by means of a "T" fitting. Air-blast intensity is accurately set by reading the system pressure (one solenoid valve open) while adjusting the pressure regulator: once set, pressure is virtually constant. Solenoid valves

are available from several manufacturers—those used in the present study were No. 1261 liquid feeders from Foringer and Company.

C. PROCEDURE

Twenty-four healthy male and female cats were trained in this apparatus at pressures between 30 p.s.i. and 40 p.s.i. inclusive, with constant intertrial intervals (ITI) varying from one-quarter minute for some Ss to three minutes for others. The CS-US interval was constant at nine seconds for 16 cats; for the other eight cats it varied between nine seconds and 11 seconds. Sessions consisted of 20 trials per day. No cat was trained more than three sessions. All trials were experimenter-terminated when the cat crossed a sighting vane nine inches from the hurdle.

D. RESULTS

All but three cats escaped the first blast and the first avoidance response was emitted in a median of five trials. Fifty-four per cent of all cats attained a 70 per cent avoidance criterion in a median of six trials to criterion, and 61 per cent of the 18 cats tested² achieved a 90 per cent avoidance criterion in a median of eight trials to criterion. Four cats never avoided, but either escaped on most trials (one cat) or crouched in one compartment on most trials (three cats). Neither ITI nor CS-US interval exerted statistically significant effects upon rate of avoidance response acquisition.

The rate of avoidance response acquisition to criterion observed here is unusually rapid and represents as little as 2 per cent (4) and 4 per cent (10) to a high of 30 per cent (5) of the number of trials necessary for cats to learn a shuttle avoidance in other experiments. Furthermore, in marked contrast to behavior usually seen in avoidance conditioning with electric shock, only one cat defecated and one other urinated: emotionality was low.

Apparatus dimension is a significant independent variable in avoidance learning experiments (3). So, also, is the type of unconditioned stimulus. This apparatus provides an efficient shuttle-avoidance situation that can be used in the study of punishment and aversion, in which nearly all experiments used in the study of punishment and aversion, in which nearly all experiments have used electric shock (2, 11, 12). Further, it offers an opportunity to observe the electrophysiological correlates of avoidance response acquisition free of electric-shock artifacts. Finally, the air-blast technique is no less reliable and is more efficient than electric shock.

² Six cats were trained only one session and not allowed to demonstrate a 90 per cent criterion. Of these six, four were avoiding regularly by the 20th trial, and three of the four had already attained at least 60 per cent avoidance.

E. SUMMARY

A shuttle-avoidance apparatus for cats that uses air blast as the unconditioned stimulus is described, and the performance of 24 subjects is summarized.

Emotional upset was slight and avoidance responding began in a median of five trials. Acquisition occurred rapidly and 13 cats attained a 70 per cent avoidance criterion in a median of six trials to criterion; 11 cats attained 90 per cent avoidance responding in a median of eight trials to criterion. Four cats did not avoid.

Rate of air-blast avoidance acquisition was compared with electric shock acquisition rate, and some uses of the air-blast apparatus were suggested.

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AGE DIFFERENCES IN WECHSLER MEMORY SCALE SCORES*¹

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A. INTRODUCTION

Among the questions most frequently asked about an elderly institutionalized individual is, "How is his memory?" The Wechsler Memory Scale (WMS) (10) is probably the most commonly used formal tool for evaluating the memory functioning of elderly individuals. Its relative popularity is based on its lack of competitors, shortness, ease of administration, and the fact that it allows for an age-corrected Memory Quotient (MQ) that can be interpreted as an estimate of memory functioning more or less as *IQ* is interpreted as an estimate of general intellectual functioning. However, when Wechsler designed the scale, he apparently did not intend it for use as a clinical tool for evaluating the memory functioning of very elderly individuals. His standardization population included approximately 200 normal Ss, ages 25 to 50, and his correction scores for age extend from ages 20 to 24 and 60 to 64. Wechsler's major statement concerning the potential utility of the scale is that "... it should be useful in detecting special memory defects in individuals with specific organic brain injuries and may prove of concrete value in the examination of some soldiers and sailors returning with head injuries" (10, p. 90). Several investigators [e.g., Cohen (4); Howard (6); and Carroll (3)] have examined the efficacy of the scale for differentiating between patients in different diagnostic categories, but little if any research has been designed to evaluate the validity and usefulness of the scale as a test of the memory functioning of older individuals.

Problematic in comparing the memory functioning of different age groups and estimating the efficiency of memory functioning of specific individuals on the basis of WMS scores is the question of whether memory functioning is the primary determinant of the WMS score. Superficially, it appears that performance on Test I (information) and Test II (orientation) is determined chiefly by the memory factor, but even these tests are not pure measures of

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memory functioning, since a few individuals may not be able to answer questions, such as "What day is it?" or "Who is the mayor?" because the information had not been acquired rather than because it was forgotten. Score on Test III (mental control) is probably influenced more by nonmemory variables, such as flexibility and speed, than by memory efficiency. Test V (digit span) is generally accepted as a measure of immediate memory, but the score on this test is almost certainly influenced also by learning ability. Wechsler pointed out that Tests I and II and to a lesser extent Tests III and IV discriminate very little between normal and near normal subjects. These tests were included as an easy technique to identify gross disorders, such as aphasia and severe senility, and for such purposes the tests are useful. Thus, total raw score on the WMS varies primarily as a function of score on Tests IV (logical memory), VI (visual reproduction), and VII (associate learning). For Tests IV and VI, in which the examinee is asked to reproduce material that has been presented only once, it is impossible to partial out the contributions of learning and memory on performance. Test VII is a straightforward learning task. Consequently, it may be that the total score on the WMS reflects to a large extent learning ability rather than memory functioning.

The present research was designed to examine WMS scores by age groups and relate WMS scores to independent measures of learning. It was predicted that a very large proportion of the age-related decline in WMS raw score, probably at least three-quarters, would be based on age-related declines on Tests IV, VI, and VII; and that scores on these three tests would correlate more highly with independent measures of learning than with independent measures of recall.

B. PROCEDURE

The WMS was administered routinely to all adult Ss who participated in three other experiments. WMS scores were obtained for a total of 237 Ss including persons in the age ranges 15 to 17, 30 to 39, 60 to 69, 70 to 79, and 80 to 89. The 15- to 17-year-olds were high school students or recent drop-outs; the 30- to 39-year-olds were hospitalized veterans; the 60- to 89-year-olds were a composite of hospitalized veterans, residents in homes for the aged, and members of Golden Age Clubs. To participate in the other experiments, Ss had to be able to follow instructions and to see, hear, and speak reasonably well. Hospitalized veterans and residents in homes for the aged with diagnoses of psychotic disorder or organic brain damage were excluded. It is improbable that any of the noninstitutionalized Ss carried such diagnoses. All Ss for whom independent measures of learning and retention are presented were institu-

tionalized, either in a veterans hospital or in a home for the aged. It cannot be claimed that the *Ss* represented random samples from the general population in the selected age groups. However, the lack of randomness is partially compensated for by the fact that age groups were equated for level of intellectual functioning as estimated by vocabulary score of the Wechsler Adult Intelligence Scale. A mean raw vocabulary score of approximately 40 (scaled score 10+ to 11—) suggests that, on the basis of prime intellectual capacity, the age groups are comparable and are reasonably representative of the general population.

Ss for whom WMS scores are available participated in either a learning-retention, an interference, or a mediation experiment. Appropriate learning and recall scores for comparison with WMS scores were available for only the 171 *Ss* who participated in the learning-retention study. In this experiment, seven pictures of people paired with names were presented to *Ss* aged 30 to 39, 60 to 69, 70 to 79, and 80 to 89, under one of three conditions: equal learning opportunity, learning to criterion, and overlearning. Since learning conditions were identical for all *Ss* up to the fifth trial, number of correct responses during the first five trials was used as the learning score for correlation with WMS scores. Recall score used for correlation with WMS scores was number of names recalled correctly 20 minutes after completion of acquisition training. Because recall scores for *Ss* in the equal learning opportunity groups varied directly with number of correct responses during acquisition, recall data from the equal learning opportunity groups were not included in the correlations with WMS. Separate *r*'s were calculated between WMS scores and recall scores by age groups for *Ss* in each of the learning-to-criterion and overlearning experimental conditions and were averaged by means of a *Z'* transformation to obtain a composite *r* between WMS score and recall score.

Early in this study, administration of Test II of the WMS was discontinued because some of the elderly *Ss* appeared to be irritated by questions, such as "What is the name of the place you are in?" and "In what city is it?" Apparently they felt that such questions reflected a low opinion of their mental status. With these *Ss* it is likely that there would have been few errors on Test II had it been administered, with the possible exception of the item, "What day of the month is this?" In calculating the WMS raw score it was assumed that all *Ss* had answered all items of Test II correctly.

C. RESULTS

Table 1 presents the means and *SDs* for subtest scores on the WMS, WMS raw score, vocabulary, and education. Wechsler's data for age groups 20 to 29 and 40 to 49 are included for comparison purposes and to provide

a more complete age coverage. Two variables exclusive of age might have contributed to the observed age-related decrement in WMS scores. These are educational level, which varied inversely with age, and health status, for which the 15- to 17-year-olds and Wechsler's 20- to 29- and 40- to 49-year-olds presumably had an advantage, since none of the *Ss* in these groups were hospitalized whereas the majority of *Ss* in the 30 to 39 age group and the three older age groups were either hospitalized or residents in homes for the elderly.

Table 1 indicates that scores on all subtests of the WMS decrease from the youngest to the oldest age group. There is a discrepancy of 17.75 points between the mean raw scores of the 15- to 17- and 80- to 89-year-olds. When age groups (excluding Wechsler's 20- to 29- and 40- to 49-year-olds) were compared by analysis of variance, the *F* for Test I was significant beyond the 5 per cent level of confidence, and for all other WMS subtests and for WMS raw score the *F* was significant at or beyond the 1 per cent level of confidence. Age-related differences for Tests I and III (information and mental control) were extremely small (mean discrepancies of .31 and .17 between the youngest and oldest groups), and for neither test did the observed difference appear to be a function of either learning or memory ability. Most errors on Test I were made for the question "Who is the mayor?" and were made by people who were hospitalized or institutionalized in a city that they did not consider "home." Variations in score on Test III were chiefly a function of speed. For these reasons, scores on Tests I and III were not subjected to additional statistical analysis.

Table 2 presents comparisons by *t* test between age groups for Tests IV, V, VI, VII, and WMS raw score. The 15- to 17-year-olds were superior to the 30- to 39-year-olds for only Test IV and raw score, but were superior to the three older groups for all of Tests IV, V, VI, VII, and raw score. The 30- to 39-year-olds were superior to all older groups on all measures except Test IV. The 60- to 69-year-olds were not significantly superior to the 70- to 79-year-olds on any measure, but earned significantly higher scores than the 80- to 89-year-olds on Tests VI and VII and raw score. There were no statistical significant differences between the 70- to 79- and 80- to 89-year-olds.

The highest scores on all subtests were earned by either the 15- to 17-year-olds or Wechsler's 20- to 29-year-olds. Either of these groups, composed of active, healthy young people relatively representative of their age groups, could serve as an appropriate base for evaluating the decrement of older groups. Since additional data were available for the 15- to 17-year-olds, this

TABLE 1
MEANS AND *SDs* FOR WMS SUBTESTS, WMS RAW SCORES, VOCABULARY, AND EDUCATION

Age	<i>n</i>		I Infor- mation	III Mental control	IV Logical memory	V Digit span	VI Visual Repro- duction	VII Associate learning	Raw score	Vocab.	Educ.
15-17	43	Mean	5.91	7.09	10.37	11.37	10.60	15.71	66.05	40.21	11.58
		<i>SD</i>	.48	1.96	3.50	1.80	2.84	2.96	8.56	12.17	.87
20-29 (Wechsler)	50	Mean	5.96	7.50	9.28	12.30	11.00	15.72	68.10	102.90*	?
		<i>SD</i>	.02	1.97	3.10		2.73	2.81	6.47	5.46	
30-39	53	Mean	5.56	6.75	7.99	11.02	10.09	15.48	61.89	41.46	10.70
		<i>SD</i>	.72	1.92	2.95	1.93	3.01	3.48	8.71	16.68	2.31
40-49 (Wechsler)	46	Mean	5.70	6.61	8.09	10.28	8.35	13.91	58.78	102.00*	?
		<i>SD</i>	.40	1.90	2.52		3.17	3.12	7.12	6.58	
60-69	70	Mean	5.47	6.24	7.34	9.91	6.03	11.94	51.93	42.21	8.91
		<i>SD</i>	1.16	2.29	2.90	1.58	3.72	4.53	11.02	16.84	3.06
70-79	46	Mean	5.24	5.63	7.35	9.91	4.95	10.98	50.46	39.49	8.64
		<i>SD</i>	1.03	2.46	3.83	2.51	3.42	4.78	12.14	15.84	2.64
80-89	25	Mean	5.60	6.92	6.80	10.00	4.00	9.98	48.30	40.52	8.60
		<i>SD</i>	.24	2.02	3.19	2.35	2.38	3.28	9.76	14.61	2.82

* Bellevue *IQ* rather than raw score for vocabulary test.

group was chosen as the base for comparison. Table 3 presents the mean scores for each age group as a proportion of the mean score of the 15- to 17-year-old group. The three older groups earned mean raw scores approximately 25 per cent lower than that of the youngest group. The drop in mean score from the youngest to the three oldest groups combined was only 8 per cent for Test I, 12 per cent for Test III, and 13 per cent for Test V. The drop in mean score from the youngest to the three oldest groups combined was 21 per cent, 53 per cent, and 30 per cent for Tests IV, VI, and VII respectively. Tests IV, V, and VII account for 78 per cent of the drop in raw score

TABLE 2
COMPARISONS BY 1 TEST BETWEEN AGE GROUPS FOR WMS SCORES

Comparison groups		IV Logical memory	V Digit span	VI Visual repro- duction	VII Associate learning	Raw score
15-17 (<i>n</i> = 43)	30-39	3.90**	.85	.77	.37	2.32*
	60-69	5.32**	3.56**	7.25**	6.18**	8.75**
	70-79	4.84**	3.32**	8.07**	7.06**	8.78**
	80-89	15.52**	2.74**	8.15**	7.44**	8.91**
30-39 (<i>n</i> = 53)	60-69	1.20	3.08**	6.77**	6.21**	6.59**
	70-79	1.07	2.78**	7.67**	7.03**	6.80**
	80-89	1.65	2.13**	7.71**	7.33**	7.18**
60-69 (<i>n</i> = 70)	70-79	.02	.00	1.69	1.55	.81
	80-89	.72	.20	2.64*	2.68**	2.14*
70-79 (<i>n</i> = 46)	80-89	.74	.18	1.16	1.28	1.39

* Significant beyond the 1 per cent level of confidence.

** Significant beyond the 5 per cent level of confidence.

from 15 to 17 and 60 to 69, 90 per cent of the drop in raw score for the 70- to 79-year-olds and 87 per cent of the drop for the 80- to 89-year-olds. Obviously, age differences in raw score are determined primarily by performance on Tests IV, V, and VII, the three tests for which learning efficiency and memory efficiency appear to be especially confounded.

Table 4 presents correlations between raw score and each of education and vocabulary, and between Test VII and each of Tests III, IV, V, and VI. The *r*'s between raw score and education tended to be relatively low, and between raw score and vocabulary to be generally high, except for the 15- to 17-year-old group. In fact, for the three oldest groups the *r* between raw score and vocabulary was sufficiently high to suggest that for elderly *S*s estimates of the efficiency of memory functioning might be made almost as adequately from the vocabulary score as from the WMS, if, indeed, either score reflects memory efficiency. Correlations between Tests VII and IV and

TABLE 3
MEAN WMS SCORES OF DIFFERENT AGE GROUPS AS A PROPORTION OF WMS SCORES OF 15- TO 17-YEAR-OLDS

Age	I Information	III Mental control	IV Logical memory	V Digit span	VI Visual reproduction	VII Associate learning	Raw score
15-17	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20-29	1.01	1.06	.89	1.08	1.04	1.00	1.01
30-39	.94	.95	.77	.97	.95	.96	.94
40-49	.96	.93	.78	.90	.79	.89	.89
60-69	.93	.88	.71	.87	.57	.76	.78
70-79	.89	.79	.71	.87	.47	.70	.74
80-89	.95	.97	.66	.88	.38	.64	.73
60-89	.92	.88	.69	.87	.47	.70	.75
(Combined)							

VII and VI were generally higher than between Tests VII and III and VII and V, providing support for the suggestion that Tests IV, VI, and VII are tapping a common element, probably learning efficiency. Intertest correlations generally increased with increased age, substantiating similar findings reported by Botwinick and Birren (1).

Tables 5 and 6 summarize correlations between WMS test scores and the

TABLE 4
CORRELATIONS BETWEEN WMS SUBTEST SCORES AND WMS RAW SCORE
WITH EDUCATION AND VOCABULARY

Age	<i>n</i>	Raw score and edu- cation	Raw score and vocab- ulary	VII & III	VII & IV	VII & V	VII & VI
15-17	43	— .38*	.10	.07	.39**	.43**	.43**
30-39	53	.38**	.41**	.32*	.38**	.16	.31*
60-69	70	.19	.69**	.18	.35**	.20	.37**
70-79	46	.29*	.77**	.56**	.32*	.50**	.47**
80-89	25	.42*	.67**	.26	.53**	.47*	.66**
Average	237	.17*	.58**	.28**	.38**	.32**	.42**

* Significant beyond the 1 per cent level of confidence.

** Significant beyond the 5 per cent level of confidence.

TABLE 5
CORRELATIONS BETWEEN WMS SUBTEST SCORES AND LEARNING SCORES

Age	<i>n</i>	IV. Logical memory	V. Digit span	VI. Visual reproduction	VII. Associate learning
30-39	53	.32*	.21	.40**	.49**
60-69	53	.41**	.33*	.53**	.47**
70-79	39	.30	.32*	.39*	.36*
80-89	25	.64**	.52**	.43*	.46*
Average	170	.40**	.32**	.44*	.45**

* Significant beyond the 1 per cent level of confidence.

** Significant beyond the 5 per cent level of confidence.

independent measures of learning and recall. Learning and recall measures were not available for the 15- to 17-year-old group. Scores on each of Tests IV, V, VI, and VII correlated more highly with learning scores than with recall scores. The average *r* between Test VII and learning and Test VII and recall differed significantly at the 5 per cent level of confidence.

D. DISCUSSION

The data from this study demonstrate that the age-related drop in raw score on the WMS is primarily a function of an age-related decrement in

performance on Tests IV, VI, and VII, and that scores on these three tests correlate more highly with independent measures of learning than with independent measures of recall. These data suggest that the WMS may be primarily a measure of learning rather than of memory, and that the age-related drop for WMS raw score may reflect an age-related deficit in learning ability rather than an age-related deficit in memory functioning.

The contention that there is a marked deficit in memory functioning with increased age is supported by folklore, clinical reports from professional people who care for institutionalized elderly people, statements from elderly people themselves, and some empirical studies [see Jones (9), and Gilbert (5)].

TABLE 6
CORRELATIONS BETWEEN WMS SUBTEST SCORES AND RECALL SCORES

Age	<i>n</i>	IV. Logical memory	V. Digit span	VI. Visual reproduction	VII. Associate learning
30-39	33	.27	.26	.51**	.33
60-69	19	.21	.18	.04	— .01
70-79	16	.48*	.29	.43	— .06
80-89	15	.39	.08	.61*	.53*
Average	83	.32**	.22*	.43**	.23*

* Significant beyond the 1 per cent level of confidence.

** Significant beyond the 5 per cent level of confidence.

However, it is appropriate to question how much of the observed deficit is a function of memory impairment and how much of it is a function of nonmemory variables which influence the amount of material available for recall. Many investigators have demonstrated that for certain kinds of learning material presented under laboratory controlled conditions learning scores tend to decline with advanced age. Others [see Canestrari (2), and Hulicka (7)] have shown that the deficit in learning attributable to age is markedly reduced if the variance due to variables, such as health status, interest in material, and rate of presentation and responding, is removed. If it is granted that there is a true learning disability with advanced age, then given equal exposure to the material, older people should learn less and hence have less stored information available for recall. Two studies [see Hulicka and Weiss (8), and Wimer and Wigdor (11)] have demonstrated that when material is learned to the same criterion, recall scores do not decline as a function of age.

There is ample evidence that the time required to react or respond to stimuli increases with advanced age, and that the increased incidence of visual and auditory impairment among older persons limits the amount of input information. Moreover, observational evidence suggests that older people tend to be less interested in acquiring and storing information that is more or less irrele-

vant to them and that the lack of a "set" to learn and retain certain kinds of material may contribute to lower recall scores with advanced age. It is conceivable that much of the behavior of older persons, including performance on the WMS, that is interpreted as a reflection of memory impairment may, in fact, be relatively unrelated to memory functioning.

What can be inferred about the cognitive functioning of a specific elderly individual on the basis of his performance of the WMS? Presumably relatively valid inferences can be made about his orientation status, willingness to cooperate, ability to understand and follow instructions, attention span, and his ability (or willingness?) to learn material that probably has little intrinsic interest for him. Insofar as recall scores are related to orientation status, attention span, learning ability, etc., a relatively accurate estimate of the individual's ability to recall material to which he has been exposed can, perhaps, also be based on WMS performance. The WMS does not, however, appear to provide a very direct measure of memory.

There is a need for a clinical test to evaluate the memory functioning of elderly individuals, but such a test should be designed to measure the ability to recall material that was once known. Investigations of age changes and age differences in memory functioning must also incorporate controls for level of original learning as well as for the interval between original learning and the recall test.

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BEHAVIORAL AND COGNITIVE MEASURES OF CONSCIENCE DEVELOPMENT*

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A. INTRODUCTION

With the renewed interest in conscience development in the last decade, a number of studies have attempted to identify antecedents of conscience behavior in children. Since these have met with only modest success, a methodological examination of the kinds of measures used to assess conscience development seems warranted. The purpose of the present study was to explore the relation between a behavioral measure of conscience and a cognitive measure designed to tap the child's attitude toward a temptation situation. It was predicted that children who resist temptation behaviorally when no external control is present will express attitudes indicating an internalized understanding of compliance with rules.

While some data are available relevant to the present research, none of the investigations has used a cognitive measure that is related directly to the behavioral measure. Rebelsky, Allinsmith, and Grinder (6) explored the relation between confession, as assessed through projective stories, and a behavioral measure of resistance to temptation. They found that children who resisted temptation were more likely than those who yielded to tell stories involving confession. However, in a study (3) comparing Samoan and Caucasian children, a relation between the temptation test and the projective story completions was found only for a rating of the stories for the presence of remorse. Confession and restitution were not related to the temptation task. In a further study (2) of the relation between cognitive and behavioral measures of conscience development, nonsignificant associations were found between the temptation task and Piaget-type stories of moral judgment. Unfortunately Piaget's theory (5) is not precise in suggesting a relation between moral behavior and an understanding of moral rules. Rather, Piaget argues for a change with age in the reasons given for abiding by rules. A morality of constraint exists in the young child; the unilateral relation between child

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and adult imposes a morality based on obedience. By approximately age 12 a morality of cooperation, characterized by an interiorization of rules and intentionality, predominates.

B. METHOD

1. *Subjects*

Ss were 38 boys and 36 girls comprising three sixth-grade classrooms of a suburban school district. They came predominantly from upper-lower and lower-middle socioeconomic class homes, with a majority of the fathers employed as blue-collar workers.

2. *Procedure*

A ray-gun game developed by Grinder (1) was used as the behavioral measure of resistance to temptation. The apparatus consisted of a futuristic appearing ray gun, a seven-foot by 15-inch plank upon which the gun was mounted, and a $15 \times 15 \times 10$ inch plywood box. On the front of the box were two revolving illuminated rockets set behind a piece of translucent glass eight inches square, and five one-inch pilot lights evenly spaced across the front of it above the target glass. Scores from zero to five were registered on the pilot lights with each pull of the trigger of the ray gun. The scores were programmed to total 32 points on the 20 shots which the Ss were instructed to take. The Ss were left in the room alone to play the game and to record their scores on the scoring sheets provided. Badges were given as incentives for the Ss to falsify their scores. Scores over the programmed 32 points were taken as an indication of yielding to temptation.

A questionnaire essay was administered to assess the Ss' attitudes toward a temptation situation. The contents of the questions took advantage of a current newsworthy incident at a nearby military establishment.

The four questions comprising the questionnaire were printed on separate pages. Ss' answers to the first two questions were collected before questions three and four were distributed. Following are the four essay questions:

1. What current event has been in the news recently about the Air Force Academy?
2. What, if anything, have your parents and your teachers said about it?

3. *TIME* magazine, January 29, 1965, reports:

The Air Force announced last week that a well-organized group of a dozen or so cadets stood accused of stealing examination papers and offering them for sale. Air Force Secretary Eugene Zuckert said that cadets had broken the ten-year-old academy's honor code, which

says, "We will not lie, cheat, steal, nor tolerate those among us who do."

Do you think it was all right for the cadets who knew about the stolen examination papers to have tattled on the other cadets?

4. What would you have done? Would you have taken advantage of the examination papers if you had been a cadet? Give reasons.

Reasons given in response to the fourth question only were analyzed for the present study. Answers were categorized according to whether control of behavior appeared to rest in sources external to the individual or whether controls were internalized. Examples of the former type of response were as follows: parents have always forbidden cheating; the code forbids cheating; you might get caught and get in trouble. Indications of internalized control were mentions of conscience, honesty, being honorable, fairness, not taking unfair advantage over others. Ss whose responses could not be categorized according to the criteria established were omitted from the analysis.

C. RESULTS

The data giving the relation between the behavioral measure and the essay responses categorized according to externalized *vs.* internalized are

TABLE 1
COMPARISON BETWEEN BEHAVIORAL AND COGNITIVE MEASURES
OF CONSCIENCE DEVELOPMENT

Cognitive measure	Behavioral measure	
	Yield to temptation	Resist temptation
Externalized	19	20
Internalized	9	10

Note: $\chi^2 = .01$, not significant.

given in Table 1. The results for the boys and girls were combined because of the small Ns in the internalization category. The chi square was not statistically significant. It is apparent also that a majority of the children at this age level gave responses indicating externalized control.

D. DISCUSSION

The present findings do not support Piaget's contention (5) that, by the age of 12, children judge behavior according to comprehensible and interiorized rules rather than evaluating it in terms of conformity to rules. They are in disagreement also with Medinnus' finding (4) that a majority of 12-year-olds give internalized reasons in response to the question, "Why is it naughty (wrong) to tell lies?"

The results support those of previous investigations in showing little asso-

ciation between a child's actual behavior and his verbally expressed attitudes. While this would seem not surprising at younger age levels, one might expect greater congruence by 12 and 13 years of age. Since no external control was present in the behavioral situation, it would seem that those who resisted temptation did so because of internalized attitudes (i.e., conscience). However, they did not express such attitudes more frequently than those who yielded to temptation in the absence of fear of detection. The results may be explained in part by considering motivations for behavior. A strong incentive for falsifying scores was present in the behavioral situation, whereas the cognitive measure seemed to tap the child's "objective" moral knowledge, free from contaminating pressures. At any age level children's behavior in a temptation situation certainly is a function of the strength of motivation. Further, the oft-noted distinction between moral conduct and moral knowledge may apply here. Grinder's conclusion (2) that "one ought to speak not of conscience but of consciences" may well be an accurate appraisal of the situation, at least in terms of levels of conscience development during the childhood years.

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INTERINDIVIDUAL RECOGNITION IN ALBINO RATS*¹

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A. INTRODUCTION

In many animal species, each colony member can distinguish between other colony members and recognize them as specific individuals. Such recognition, of course, reaches its peak in man. As in man, interindividual recognition in the great apes seems to be highly developed. Evidence of interindividual recognition capacity in other primates comes mainly from observations of dominance behavior. For example, group-caged rhesus monkeys rapidly achieve, and maintain, stable dominance hierarchies, thereby indicating that a particular animal comes to know his status by identifying, and remembering, those animals that are both above and below him in rank (5, 14, 17). Evidence of such recognition behavior has also been found in both domestic and wild birds (8, 11, 18).

The capacity for interindividual recognition within a given species apparently depends upon the evolutionary development of particular sensory modalities and upon the degrees to which individuals differ from one another in cues detectable by vision, audition, olfaction, tactition, etc. Although multi-sensory cue utilization is common in the higher phyla, it appears that usually one or two cues predominate. In many mammals and birds, vision has been shown to be the most important sense modality for interindividual recognition. Davis (8) has pointed out that, this being the case, it becomes important to determine for various species whether behavior or physical appearance is the principal basis for visual discrimination. Studies on dominance modification indicate strongly that rhesus monkeys recognize other members by individual differences in appearance (14, 17). Guhl and Ortman (11) demonstrated that chickens recognize each other not so much by behavioral cues but mainly by cues connected with the head. Davis (8) maintains that physical appearance cues are of greatest importance in recognition among most wild species of birds, but, at the same time, he points to the importance of behav-

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ioral and auditory cues, especially for those species in which both sexes are similar in plumage, such as the heron. The olfactory sense seems to contribute little or nothing to social recognition in birds.

Beach and Jaynes (3, 4), however, found that olfactory cues were very critical for the lactating female rat, which was given the task of distinguishing between her own pups and those of another litter. These investigators showed that female rats retrieved their own pups in preference to alien pups, but when the mothers were rendered anosmic or when the young were sprayed with oil of lavender, the discrimination could no longer be made. Odor is also important for sex discrimination in rats and in other mammals (13).

It seems doubtful that invertebrates possess the necessary sensory equipment and an adequate range in morphological variation for interindividual recognition as such. In a comprehensive study of behavior in field crickets, Alexander (1) concluded that no information is retained from encounters that cause crickets to respond differently in subsequent encounters with the same individual. That is, crickets cannot seem to remember or recognize other crickets from previous experience with each other.

One of the current problems with reference to interindividual recognition concerns the order *Rodentia* with special reference to the genera *Rattus* and *Mus*. Most of the research related to interindividual recognition among the species of these genera has produced conflicting evidence. Seward (20, 21) investigated aggression in rats and was unable to find stable dominance hierarchies. This, perhaps, suggests that rats cannot recognize each other. However, Grant and Chance (10) criticized Seward's method of housing animals individually before pairing because forced social isolation ignores much of what is known about the formation of hierarchies in many animal societies within which the members are in continuous social interaction. These investigators observed encounters of different numbers of rats caged together over an extended period of time and found that males developed stable rank-orders in cages containing five animals but not in cages containing six. It may be that interindividual recognition in albino rats becomes difficult when the group reaches six or more members. In a study on dominance behavior in mice, Ginsburg and Allee (9) reported that C-57 blacks quickly establish and maintain a linear order, whereas C-34 agoutis and C (Bagg) albinos do not.

In a study unrelated to dominance, Tolman (22) found that 22-day-old rat pups could discriminate among individuals of their own species. By using a short Y-maze, he found that pups preferred age-mates over adults and unfamiliar over familiar animals. In this study, however, no attempt seems to have been made to identify the cues involved. In a comprehensive field study

of the Norway rat, Calhoun (7) suspects that rats learn to recognize actions and postures that characterize dominant and submissive patterns of behavior, but he doubts that rats are recognized as individuals by other rats solely by physical appearance.

The purpose of the present study was to determine whether or not albino rats have the capacity for individual recognition of cage mates and, if possible, to identify the cues involved if there is such recognition capacity. Briefly, the method was to house together groups of three rats that were alike in sex, age, and size; then, in a two-choice discrimination apparatus, to train each rat to approach one cage mate and to avoid the other. The procedure allowed the discriminating animal to use sensory modalities of vision, olfaction, audition, and taction when making a choice between cage mates.

B. METHOD

1. Subjects

Animals used in the experiment were two litters of 13 albino rats (Sprague-Dawley, Simonsen strain) each. At 21 days old, all were weaned; matched by sex, weight, and litter; and housed as trios in wire cages ($7\frac{1}{2} \times 11 \times 7$ inches) for the duration of the experiment. One litter contained nine females and three males; thus, for the experiment, it contributed three cages of females and one cage of males. The other litter contained six females and six males, and so contributed two cages of females and two cages of males. Each animal was identified in its cage as Number 1, 2, or 3 by ear slits. Water and food pellets were provided *ad libitum* until the animals were 50 days old, when they were placed on a 22-hour food deprivation schedule and given food only during testing and for an hour afterwards.

2. Apparatus

The apparatus is shown as Figure 1. It was a $\frac{3}{8}$ -inch plywood discrimination box, painted flat gray. Fastened to one end of the apparatus was a starting box equipped with a guillotine door. At the opposite end, and 17 inches from the starting box, were two goal boxes. These were spaced 1-inch apart and separated from the discrimination chamber by a 1-inch-square wire mesh. Each goal box was equipped with a 3×3 -inch clear plastic door, which swung upward, permitting one-way passage into the goal box. Clear plastic sliding doors were attached to both sides of the apparatus and were used as an extra control to prevent animals from escaping the goal boxes. The floor of each goal box consisted of an electric grid of $\frac{1}{8}$ -inch copper rods, spaced $\frac{1}{2}$ -inch apart and connected to a Variac stimulator. An a.c. electric shock could be

delivered to either of the goal boxes by push-button control. Each goal box was equipped with a food well that received a 45 mg standard rat food pellet from a small brass tube. A $\frac{1}{4}$ -inch-square wire mesh covered the top of the apparatus.

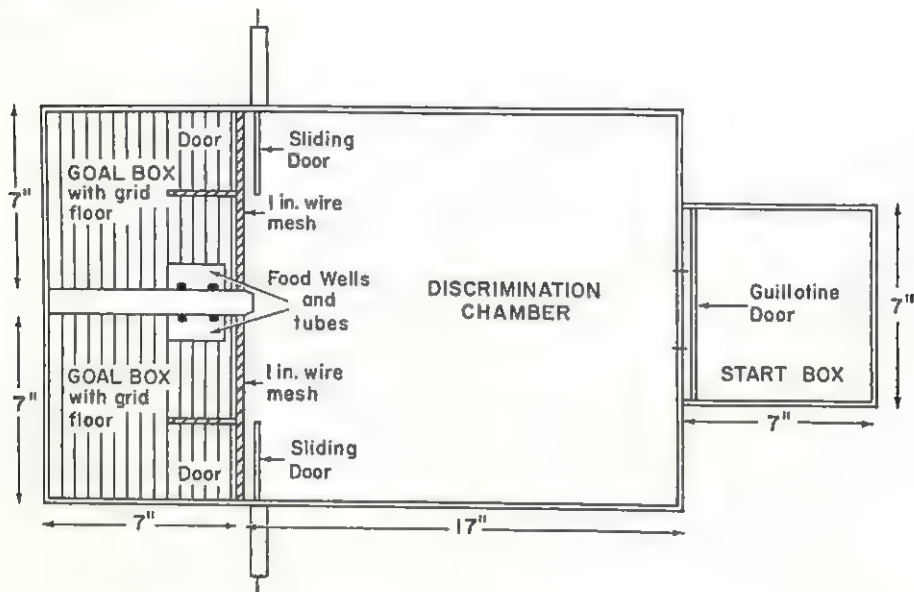


FIGURE 1
THE APPARATUS

3. Procedure

At the beginning of a trial, *S* was placed in the starting box and released into the discrimination chamber by raising the guillotine door. The two litter mates of *S*, the Stimulus-Subjects (*S-S*), served as the stimuli to be discriminated. Positive and negative goal boxes were determined by the position of positive or negative *S-S*. If *S* entered the goal box designated as positive (correct response), two or three small food tablets were dropped down the brass tube into the food well. If *S* entered the negative goal box (incorrect response), it received an a.c. shock of 50 volts for an approximate one-half-second duration. The *S* was then removed from the goal box and again placed in the starting box to begin another trial. The left-right position of the positive and negative *S-S* was varied from trial to trial according to a balanced irregular sequence. A response was designated when the base of *S*'s tail had passed the sliding doors upon entry into the goal box. This also permitted *S* to come

into contact with *S-S* before making a response. The noncorrection technique was used throughout, permitting *S* to make only one response per trial.

The experiment was conducted in three phases. Phase 1 was an adaptation series of trials in which no *S-S*s were used. All *S*s were given 90 trials to approach an empty goal box while the other goal box was blocked by the sliding door. After this, all *S*s responded with sufficient regularity to begin Phase 2. In Phase 2, only one *S-S* was used. All *S*s were trained to approach a positive *S-S* and to avoid an empty goal box. If the *S* entered the goal box containing the positive *S-S*, both the *S* and the *S-S* were fed. However, shock was given if *S* entered the empty goal box. Each *S* was tested 20 trials a day for four days; this was sufficient for asymptotic performance. In Phase 3, both positive and negative *S-S*s were used. The procedure was similar to Phase 2, except that if *S* entered the goal box containing the negative *S-S* both animals received shock. All three animals, including the negative *S-S*, were fed if *S* entered the goal box containing the positive *S-S* (correct response). Each *S* was given 20 trials a day until a criterion of 18 out of 20 responses to the positive animal was reached on a given test day.

The study was so designed that five different comparisons could be made. (a) The performances of males and females were compared to determine if there is a sex difference in discriminating between cage mates. (b) Two arrangements were designed in which the performances of six *S*s were compared with those of 12 other *S*s. The six *S*s were animals Nos. 1 and 2 from three cages: these having been trained to approach each other and to avoid animal No. 3 (Arrangement 1). That is, animals Nos. 1 and 2 experienced both the *S* role and the positive *S-S* role, whereas animal No. 3 experienced only the negative *S-S* role. Combined, the 12 *S*s were all the animals from four cages. They were, in this case, trained in a circular way (Arrangement 2). Explicitly, animal No. 1 was trained to approach animal No. 2; animal No. 2 was trained to approach animal No. 3; and animal No. 3 was trained to approach animal No. 1. In each case, the animal that was avoided was the one left over: i.e., the animal not being approached. Therefore, all three animals in this arrangement experienced the roles of being an *S*, a positive *S-S*, and a negative *S-S*. Subjects were alternated from day to day as to which would begin the test session. This comparison was designed to determine if differences in behavior of the *S-S* in the two different arrangements would result in differences in the number of errors to criterion between the two arrangements. (c) The third comparison included the 12 *S*s in Arrangement 2, which were run for four days in Phase 2. On the following day (Phase 3), six of the *S*s were trained to approach the same *S-S* approached in Phase 2 (nonshift group),

whereas the remaining six Ss were trained to avoid the S-S approached in Phase 2 (shift group). This was done to determine if any specific cues connected to the positive S-S in Phase 2 had been learned and, hence, transferred to Phase 3. If any positive transfer of learning occurred, the nonshift group would be expected to perform better than the shift group on the first day of Phase 3. (d) Another transfer of training effect was made in which the 12 Ss in Arrangement 2 were tested to criterion. The next day the Ss were tested again but with the S-Ss reversed. That is, the positive S-S now became the negative S-S and vice versa. (e) Five Ss were trained to 90 per cent correct responses for two consecutive days. On the following day, in the attempt to eliminate as many as possible of the behavioral cues involved in cage-mate discrimination, both the positive and negative S-Ss were anesthetized with an intraperitoneal injection of nembutal. They were then placed in the goal boxes for S to discriminate. The usual procedure was employed for 20 trials. If the five Ss performed at chance level when responding to anesthetized S-Ss, behavioral cues would be suspected as being predominantly important in inter-individual recognition.

C. RESULTS

All Ss reached about 94 per cent correct response at the end of Phase 2. With the introduction of another S-S (Phase 3, day 1), performance dropped to around 56 per cent correct responses for all Ss. Males made fewer errors to criterion than females (means of 58 and 48, respectively), but this difference was not significant ($t = 1.06$, 10 *df*).

The Arrangement 2 Ss made over three and one-half times more errors in reaching criterion than the Arrangement 1 Ss (means of 54 and 15, respectively; $p = .001$, $t = 6.56$, 16 *df*). This indicates that the S-Ss in Arrangement 2 produced cue variables much more difficult to discriminate than those produced by S-Ss in Arrangement 1.

Although no differences existed between the shift and nonshift groups in overall performance to criterion, it was the shift group that made on the average fewer errors than the nonshift group on the first day the shift occurred (Phase 3, day 1; $p = .01$, $t = 3.99$, 10 *df*). This finding is contrary to expected prediction, since shifting an S-S from positive to negative produced no negative transfer effect but instead had facilitating effects in comparison to the nonshift group. The mean per cent correct response for Ss in the nonshift group was slightly below chance (45 per cent), whereas the performance of Ss in the shift group was 15 per cent above chance (65 per cent).

The reversal of S-Ss following criterion resulted in an average drop in

performance of 60 per cent, or about 30 per cent correct response. This indicates a definite negative transfer effect.

When the *S*-*S*s were anesthetized with nembutal—following two days of criterion performance by five *S*s—responses to these *S*-*S*s dropped to chance level, or to about 53 per cent. This indicates that no discrimination or recognition was now being made.

D. DISCUSSION

The results of this experiment indicate that albino rats are capable of discriminating between cage mates similar in weight, age, and sex; the capacity to discriminate appears to be based principally, if not solely, upon behavioral cues.

The test situation was such that *S* had to make some distinction between cage mates to maximize reward (food) and minimize punishment (shock). It was possible, in this case, for an animal to make this distinction by vision, olfaction, taction, audition, or a combination of such cues. However, it became apparent to the observer that *S*s were most probably using visual cues of behavior displayed by the *S*-*S*s. The procedure of shocking the negative *S*-*S* and feeding the positive *S*-*S* resulted in each *S*-*S*'s developing a particular pattern of behavior when approached by *S*. This was especially true in Arrangement 1, where *S*-*S*s were given either the positive or negative role but never both. A "freezing" or immobile type of behavior on the part of the negative *S*-*S* whenever *S* was released into the discrimination chamber soon developed, especially when *S* attempted to enter the negative goal box. On the other hand, the positive *S*-*S*, which never received shock with the *S*, became considerably more active than the negative *S*-*S*, especially in displaying searching behavior at the food well.

This behavioral difference between positive and negative *S*-*S* was much less evident in Arrangement 2, in which all three cage mates experienced both positive and negative roles. Under these conditions, it was often observed that both the positive and negative *S*-*S*s displayed similar "freezing" or immobile patterns of behavior, whereas such similarities never occurred in Arrangement 1. An obvious explanation for this is that "freezing" behavior, which frequently developed under the conditions of the negative *S*-*S* role, was transferred to the positive *S*-*S* role whenever the animal was switched to that role. It therefore follows that *S*-*S*s in Arrangement 2 would have much more difficulty in developing consistent and distinctive behavioral patterns for each *S*-*S* role than would be the case for *S*-*S*s in Arrangement 1. This apparent distinctiveness in behavioral cues of Arrangement 1 as compared to Arrange-

ment 2 may also explain why *Ss* in Arrangement 1 reached criterion much sooner than those in Arrangement 2.

The nonshift *Ss* apparently did not learn to identify or recognize the positive *S-S* during Phase 2, since performance dropped to chance level on the first session of Phase 3 in which two *S-Ss* participated. However, some degree of preference or discrimination seems to have been made by the shift *Ss* in Phase 3, but in the opposite direction predicted. It is impossible to understand now why *Ss* preferred the newly introduced cage mate to the one approached in Phase 2. Until such preference cues are identified, any attempt to interpret this phenomenon would be pure speculation.

A great amount of negative transfer occurred in Arrangement 1 when the two *S-Ss* were reversed after criterion, much the same as one would expect if objects or patterns were used instead of cage mates. In this case, however, the success of *S* in reaching criterion seems to depend, to a large extent, upon the ability of *S-S* to distinguish the two roles and to "communicate" to *S*, in some behavioral way, whether food or shock would follow. This is supported by the fact that discriminations by *S* could no longer be made when the *S-Ss* were anesthetized; thus indicating that, under these testing conditions, behavioral cues, rather than physical appearance cues, were of foremost importance in cage mate discrimination.

It seems unlikely that animals housed together could develop individual odor cues for use in interindividual recognition. Estral odors, while identifiable (13), would have played no cue role in this experiment, since the *Ss* were used for periods lasting longer than the total cycle. Food odor cues and chewing cues were controlled, since both *S-Ss* were fed when *S* made a correct response.

These results tend to indicate that a stable dominance hierarchy, based upon the recognition of interindividual cues of morphology, is improbable in albino rats. The stable rank order of albino rats in the Grant and Chance study (10) was estimated by taking the ratio between totals of wins and losses of bouts, for each rat, under "natural," noncompetitive circumstances. Although these win-loss ratios were relatively stable over a period, there was no indication that a given animal maintained its status by any sort of recognition of dominant or submissive cage mates. In fact, the data suggest otherwise—that dominance is expressed more likely in terms of degrees of pugnaciousness, without much regard for individual selectivity. For example, Grant and Chance observed over 120 instances in which the most "submissive" animal won bouts over the most "dominant" animal. Such instances have never been reported to occur in adult nonhuman primates. In the rhesus monkey, dominance behavior, almost without exception, is expressed in a downward

direction: i.e., from the most dominant to the most submissive animal (6). It therefore seems that a stable dominance hierarchy in rats is dynamically unlike a stable dominance hierarchy in monkeys—the former being based upon maintaining certain levels of belligerence, the latter being based upon sustained expressions of social selectivity and enormously complicated interindividual relationships.

Until now, interspecies comparisons of social organizations and of social behavior of individual animals have been described mainly in terms of such factors as "sexual bonds" (24), dominance behavior (15, 16), heredity (2, 19), and more recently in terms of ecology (12, 23). Little attention has been given to the role that interindividual recognition may play in explaining some of the basic differences between social structures of different species. The capacity to recognize other members may, for example, explain some of the differences between rat and monkey societies.

Rats have usually been described as having little "social motivation" and as being organized into "impersonal" groups lacking importance to the individual (2, 19). On the other hand, the nonhuman primate is next to man in expressing a high degree of "social motivation" with emphasis on individual selectivity and individual preference. No doubt, much of the social organization of the laboratory albino rat is genetically determined, but this "impersonal" social organization closely parallels the rat's apparent inability to recognize other members by morphological cues. The superior vision and the great range of morphological variation in monkeys, without doubt, enables them to respond to specific individuals and to display social preferences based upon systems of social rewards and punishments. Such a system of interindividual relationship has not been observed in laboratory rats.

It is quite probable that, in their native habitats, rats have more cues at their disposal, especially those of odor. The "recognition behavior" of nose-touching in Norway rats (7) probably involves a combination of olfactory, visual, tactual, and behavioral cues; rats that actively avoid others from distances as great as 10 feet are probably responding to behavioral cues or to stimuli that represent the animal being avoided. Until these types of recognition behavior are subjected to experimental tests, our knowledge concerning interindividual recognition in lower animals must remain highly speculative.

E. SUMMARY

To investigate cage mate recognition and discrimination, 21 albino rats were caged in trios at weaning and, beginning at 50 days old, were trained in

a two-choice apparatus to approach one cage mate and to avoid the other. The roles that Subjects (*S*) and Stimulus-Subjects (*S-S*, either positive or negative) played were systematically varied. Under one arrangement, errors to criterion were more than three times the number made under another arrangement. It was tentatively concluded that this was due to the marked behavioral differences between positive and negative *S-S*s. When these behavioral differences were eliminated by anesthetizing the *S-S*s after criterional performance by *S*, discriminating responses to these *S-S*s dropped to chance level. This suggests that, under these testing conditions, behavioral cues are crucial to interindividual recognition.

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METHODOLOGICAL CONSIDERATIONS AND THE DISCRIMINATION-LEARNING DEFICIT IN THE SEVERELY RETARDED*¹

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A. INTRODUCTION

Zeaman and House (16) call discrimination learning a particularly sensitive indicator of retardation. Using a modified Wisconsin General Test Apparatus (WGTA), they have concerned themselves with identifying the basis of the low grade retardate's deficit in discrimination learning. Evidence for this deficit appears in a study by House and Zeaman (7) in which imbeciles ($MA = 2.4$) learned remarkably slower than naive monkeys (4). Considering that normal 2- to 4-year-olds ordinarily learn discrimination problems as well as monkeys (2, 5, 15), then House and Zeaman's data suggest that retardates matched on MA with normals do much worse than normals of the same MA . In fact, the data of Girardeau (3) on learning set, together with a series of WGTA studies by House, Zeaman, and associates (9, 10, 11, 16), have led House and Zeaman to assert that discrimination-learning experiments can point to a learning deficit in retardates that is untapped by intelligence tests. It is interesting to note, however, that other investigators, such as Stevenson and Zeigler (14), Stevenson (13), and Plenderleith (12), find no discrimination-learning effect for retardates matched on MA with normals. Procedural differences in these studies from the general type mentioned above may point to some important variables in the "learning deficit." Stevenson and Zeigler, for instance, used three stimulus objects rather than two, which may have inhibited the development of a simple left-right position preference. The Plenderleith and Stevenson studies may have induced better retardate learning by eliminating the two-way mirror characteristic of the WGTA. It seems possible that in the impersonal atmosphere of the WGTA situation the institutionalized retardate would be at a disadvantage as compared with more sophisticated normal children.

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That retardate population type can also be an important factor in discrimination learning seems to be indicated in a series of pilot studies by Denny and Boice (1) that investigated the influence of position preferences on this phenomenon. The noninstitutionalized retardates showed a marked superiority over institutionalized *Ss* in cooperation and apparent learning ability.

The present study was conducted with the idea that the discrimination learning deficit of the severely retarded child might diminish with the use of more socialized, noninstitutionalized subjects—and in a simulated WGTA designed for maximal reduction of fear caused by strange apparatus stimuli.

B. METHOD

1. Subjects

a. Noninstitutionalized sample. Fourteen experimentally naive subjects were utilizable at the Wood Haven Center in suburban Lansing. Available *IQ* scores without regard for diagnostic category were used as a basis for selection. The *IQs* ranged from 26 to 52 ($IQ = 36.3$), and *CAs* ranged from 8 to 23 ($CA = 16.9$). The mean *MA* of the noninstitutionalized *Ss* was 6.2.

b. Institutionalized sample. The available subjects at the Mount Pleasant Home and Training School who best approximated the noninstitutionalized *Ss* totaled 24 ($IQ = 35.0$, range = 27-43). The *CAs* of this group ranged from 11 to 16 and had a mean of 13.6 ($MA = 4.7$). These retardates had no prior experience in discrimination-learning problems.

c. Normal sample. Twelve Spartan Nursery School students were chosen to approximate the *MA*s of the two retardate groups. The average *MA* of the campus nursery group was 4.5.

2. Apparatus

A portable, simulated WGTA apparatus was used, and, as in the House and Zeaman study (6), the sliding tray contained two 3-inch food wells centered 12 inches apart. Two stimulus objects were chosen on the basis of pilot work to eliminate color or form preferences. Three-inch forms of a square and a circle were cut from $\frac{1}{4}$ -inch Masonite, mounted erect on 4- by 4-inch Masonite bases, and painted dark red and black respectively.

3. Procedure

All groups were presented with the test under an identical procedure, with only room conditions differing. Each *S* was selected singularly from a play group in a friendly manner and then was led to a small familiar room and seated across from *E*. The sliding tray was baited under the table's edge and

pushed in front of the *S* to start a trial. One stimulus object was always "correct" and the equal left-right placement of the two objects was randomly determined. *E* said "good" if the first response was correct and "no" if it was not. Specific instructions were given on each trial that only one object could be lifted. No correction of choices was allowed.

All trials were presented in one session with an intertrial interval of one minute. The criterion of learning was nine out of 10 trials. The measure of learning was the number of trial blocks to criterion.

C. RESULTS AND DISCUSSION

The first and most important result was that both the retardate groups learned in an average of less than 60 trials, whereas House and Zeaman's *Ss* (7) had a mean of 119 errors to criterion (and an easier criterion). The monkeys in the Harlow study (5), that were compared to the latter *Ss*, learned to pick up the stimulus object covering the baited food well with a median of four errors to criterion. As was expected, the combination of the face-to-face situation between *E* and *S* and the use of less anxious noninstitutionalized (NI) *Ss* in this study produced a rate of learning comparable to that found by Harlow. The NI retardates reached criterion in a mean of 4.1 trial blocks, which was not significantly worse than the mean of 3.2 trial blocks demonstrated by the normals of this study ($t = 1.18$).

The institutionalized *Ss*, however, performed at a level that was significantly different from that of the normals (mean scores > 5.8 vs. 3.2 trial blocks; $t = 2.50$; $p < .05$, corrected with Welch's procedure) and at a level that was not significantly different from the NI *Ss* (mean scores > 5.8 vs. 4.1 trial blocks; $t = 1.67$). These differences show the same superiority of the normals as in previous discrimination learning studies but differ in two important respects: (a) both retardate groups did considerably better than *Ss* enclosed in the mirrored WGTA; and (b) a noninstitutionalized group was included that performed better, although not significantly so, than the institutionalized *Ss*.

The difficulties in obtaining severely retarded subjects who allow firm comparisons bring some question to a part of these conclusions, however. Almost exact matching of the nursery school children ($MA = 4.5$) and institutionalized retardates ($MA = 4.5$) was possible. The best that could be done for matching with the more transient NI retardates ($MA = 6.2$) was to equate for *IQ* ($IQ = 36.3$ vs. 35.0). Thus, it could be said that the increased *MA* of the NI group accounted for the comparatively good per-

formance in this study. Some additional considerations of these data, however, might allow for the previous conclusions.

Partial correlations (after McNemar) were calculated to estimate the influence of *CA* and within-group *IQ* variance upon learning scores. The effect of *IQ* upon score with age partialled out for the NI retarded Ss yielded a nonsignificant (at .05) *r* of .29, and the effect of *CA* upon score with *IQ* partialled out for the same group gave an *r* of .27. These correlations suggest that neither the higher mean *CA* nor the greater *IQ* variability of the NI subjects accounted significantly for their learning speed.

Another study by House and Zeaman (8) compared two *MA-IQ* level splits (*MA* = 4-5; *IQ* = 40.4 vs. *MA* = 5-6; *IQ* = 51) in retardates with a similar split in normals. Although the higher *MA* group performed much better than the 4-5 *MA* group, it is perhaps the *IQ* level that is crucial (1). The mean *IQ* of the NI Ss of this study was 36.3 and they reached criterion at even a slower rate than the 4-5 *MA* group (*IQ* = 40.4) of the House and Zeaman study (8).

The implication is, then, that in labelling discrimination learning a special indicator of the severely retarded, one should probably generalize only to the retardate population being studied. In addition, the performance of the institutionalized group in this study might indicate a problem in adopting some kinds of apparatus (e.g., WGTA) for use with the severely retarded.

D. SUMMARY

Procedural variations were investigated as possible factors in the discrimination-learning deficit in the severely retarded (*IQ* = 25-50) as found by House and Zeaman (7). Two factors were expected to bring the performance level of the retardate closer to that of normals matched for *MA*: (a) a friendly face-to-face confrontation of *E* and *S* rather than the impersonal, mirrored situation of the WGTA; and (b) the utilization of noninstitutionalized retardates to compare with the institutionalized Ss.

Both retardate groups performed at levels considerably above that in the House and Zeaman study. Noninstitutionalized Ss reached criterion at a rate not significantly slower than the normals, whereas the institutionalized Ss performed at a lower level than either of the other two groups.

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PARENTAL BEHAVIOR AND CHILDREN'S INVOLVEMENT WITH THEIR PARENTS*¹

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A. INTRODUCTION

The concept of emotional involvement is common in popular usage: it is a term used frequently, if loosely, to denote an important, intense relationship of one person with another (or between a person and some object or goal). Translated into theoretical parlance, it is likely to evoke the concept of identification so that an attempt at a distinction between the two is necessary. Identification remains an ubiquitous term in personality theory, this despite warnings that its usage has been so promiscuous as to have interfered seriously with its descriptive worth and sapped it of its theoretical potential. Neither Sanford's plea (15) for a restriction in its referent nor Bronfenbrenner's suggestion (3) for a moratorium in its use until empirical foundations are firmer has proved an effective corrective.

Involvement, as we will be using the term, infringes the sprawling province of identification only in sharing the feature of a strong emotional tie of the child to the parent. Involvement is defined here as a motivationally neutral concept with intensity as its sole dimension of variation. Also, in no way does it imply any behavioral or felt similarity of the child to the parent with whom he is highly involved. In those respects involvement parts company with the various definitions of identification. However, we will attempt, at various points, to evaluate our results by assuming the equivalence of the two concepts. In this way, we hope to discover the contexts in which the relatively simple and straightforward notion of involvement can substitute for its more complex relative. Insofar as this strategy is effective, the present research may help to clarify the concept of identification.

The fact of an individual's involvement with another person tells us only

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¹ The author is pleased to acknowledge the contributions to this investigation made by the staff, past and present, of the Guidance Study, who participated over a span of 25 years in the longitudinal study of child development from which the present data are drawn. Very particular contributions were made by Edith Katten, who provided the ratings for this study, and to Dr. Wanda Bronson, whose continuing cooperation facilitated its completion.

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a little of the nature of the relationship. An intense involvement may be affectionate or it may be hostile; it may be motivated by neurotic needs or it may express a realistic attitude. It is a basic assumption of this report that the degree of the child's involvement with the mother and the father, independent of its quality, can contribute to an understanding of a child's family situation, and hence of some aspects of his personality development. The quality of a child's involvement with his parents is, of course, important, but we propose to test whether the gross fact of a child's being—or failing to be—highly involved with his parents is in itself a valid parameter of parent-child relationships.

The concern of the present study is, therefore, the exploration of some of the correlates of a child's involvement with his parents. Specifically, we focus upon the influence of three broad and interrelated areas of parental behavior: the exercise of authority, the giving of affection, and the emotional investment of the parent in his child. Some consideration will also be given to aspects of the child's personality development associated with the level of his involvement with his mother and father.

B. METHOD²

1. *Sample*

The data are from the Guidance Study of the Institute of Human Development, a longitudinal study whose purpose is the comprehensive investigation of physical, mental, and personality development of a broad sample of children from birth through adulthood. A full description of the original sample, which was selected to be representative of all children born in Berkeley, California, in the years 1928-1929, as well as an outline of the data-collection procedures employed in the Guidance Study, is provided elsewhere (10). The present investigation is based on the 100 families (50 boys' families and 50 girls' families) of the 122 initial Guidance Study families who afforded the most complete set of data over the longest period of time.

2. *Data and Rating Procedure*

Our materials were the full case records of the Guidance Study on each of these families. The descriptions of parental behaviors were based primarily upon clinical evaluations of intensive yearly interviews with the mother. The data were supplemented by observational material gathered outside of formal interview settings and, occasionally, by interviews with other family members.

² A more detailed description of the subsample, the rating procedures, and their reliabilities is available in the initial published report (4).

Half-yearly interviews with the child (conducted from age 6 on), analyses of projective test data, summary personality descriptions, and considerable informal observation provided the data for rating the child's level of involvement with each parent.

These basic data were ordered into dichotomized ratings (High or Low) of the level of authority, affection, and involvement shown by the mother and the father in each family toward the study child (six ratings in all), and of the child's involvement with each parent (two ratings). The ratings were made by a single rater highly familiar with the details of total case records, following an intensive review of all available information and a preparation of abstracts of relevant data. A rating of High or Low on each of the eight variables was made whenever sufficient data were available; only when there was little or no information pertinent to a given rating was it omitted. To promote the independence of parental behavior and child involvement ratings, the abstracted information referring to the child's behavior was not employed in rating parental behavior, nor were parent data reviewed for the ratings of the child's involvement. All ratings represent clinical inferences as to the true nature of each parent-child relationship rather than a literal acceptance of the self-characterizations offered by the respondents, parents or children.

3. Parental Variables

a. Authority. Rating of the level of parental authority was based upon the extent of disciplinary behavior by the parent generally considered to be recognizable and effective for the "average" child. The motivation for the discipline, and its quality, were irrelevant to the rating. High authority, therefore, ranged, in our sample, from arbitrary harshness to reasonableness and consistency. The effectiveness of the control for the particular child was also not considered; for example, the presence of highly socialized behavior in the child was not taken as evidence, *per se*, for a High rating of authority, nor was undisciplined behavior proof of Low authority.

b. Affection. This rating was based upon behavioral manifestations of warmth, acceptance, and love, sufficiently overt to be recognizable by a child. If, for whatever reason, the child was denied any visible sign of parental love, affection was rated Low. Again, the motivation of a parent and the manner in which he expresses his feelings did not enter into the rating. Thus, a rating of High affection was assigned both to compulsively "smothering" envelopment of the child and to nonintrusive affection, spontaneously expressed.

c. Parental involvement. This rating reflected the level of emotional investment that the parent had in the child, as indicated by his or her active interest

and participation in the child's life. The involvement, however, had to have been in the child, not just in his possible instrumental value to the parent as a means to furthering personal goals. (Extreme interest in the child's educational achievement, for example, would not *per se* have been considered High involvement if it represented merely the parent's attempt to elevate his own social status.) As before, only the intensity of the relationship was evaluated; High involvement may have connoted a supportive intimacy or an interfering domination.

d. Reliability. Two measures of reliability were obtained: (a) To test the self-consistency of the original rater, a randomly drawn subsample of 25 families was rerated after an interval of three years. The original order in which the families had been rated was reversed in order to prevent an inflation of reliability due to correlated practice effects. (b) To assess the reproducibility of the ratings, a second person (the author) repeated the ratings on another randomly chosen 25-family subsample. Agreement indices in both assessments were based only on rating instances where both ratings had been made (96 per cent in the first comparison, 91 per cent in the second). For the intrarater subsample, agreement was 83 per cent; for the interrater subsample, it was 82 per cent. There were no significant variations in level of agreement attributable to the sex of the child, to the sex of the parent, or to the variable rated.

C. RESULTS³

1. Sex Differences in Involvement Level and Relationships

The involvement levels of sons and daughters with their fathers and mothers are presented in Table 1.⁴ Significantly more sons showed High involvement with their fathers than with their mothers; daughters showed no significant same-sex preference. Daughters, significantly more often than sons, were strongly involved with their mothers; there was, however, no reliable son-daughter difference in level of involvement with the father. This sex difference in involvement had no obvious relation to differential treatment of boys and girls, since there were no significant son-daughter differences in any of the six measures of parental behavior. The percentages of High ratings are as follows: mothers, for sons and daughters, respectively—authority, 76 and 70;

³ Throughout this study we report the results of all statistical evaluations achieving a *p* value of .15. This liberal criterion is our preference in a study from which we wish to generate hypotheses for a new construct. However, precise probability values are reported throughout so that the reader may select his own threshold for credence.

⁴ Since occasional ratings are missing for the total 100-family sample, the *N*'s for the statistics presented in Table 1, and in Figure 1 which follows, vary somewhat. In no instance, however, is the *N* lower than 45 for girls and 44 for boys.

affection, 63 and 54; involvement, 47 and 54; fathers—again in the son-daughter order—authority, 47 and 46; affection, 53 and 60; involvement, 52 and 62.

The relationships between parental variables and the child's involvement are shown in Figure 1. (A detailed discussion of the relationships among

TABLE 1
CHILDREN'S LEVEL OF INVOLVEMENT WITH THEIR PARENTS

Group	Percentage of High involvement with Mother	Father	Significant difference ^a
Sons	46	78	.02
Daughters	71	62	n.s.
Significant difference ^b	.04	n.s.	

^a Mother-father differences evaluated by McNemar's test of difference between correlated proportions (with continuity correction).

^b Son-daughter differences evaluated by the chi-square test for independent samples (with continuity correction).

parental variables themselves was undertaken in the previous report (4); they will concern us here only insofar as they become relevant to the understanding of their relation to the present results.)

For boys and girls alike, the child's involvement with the mother was related to the mother's involvement and to her affection, two aspects of maternal behavior which themselves were positively interrelated in both boys' and girls' families. While involvement with the father for girls was a function of the level of paternal involvement, for boys no direct relationship between any aspect of the father's behavior and the son's involvement with him was found. There was only the suggestion that paternal involvement tended to preclude, or at least to have occurred in the absence of, the son's strong involvement with his mother. Correspondingly, High maternal involvement was associated with the son's failure to have become closely attached to the father. We have previously found that among girls' families only one parent tended to show High involvement in the daughter (mother's involvement \times father's involvement; $p = .04$; C (contingency coefficient) = $-.30$). In boys' families, the father's and the mother's level of involvement were independent. This difference in parental involvement patterns was paralleled in the children's response; there was a negative relationship between involvement with the father and involvement with the mother for girls ($p = .06$; $C = -.25$); no relationship between the two was found for boys.

Considered together, these results fall into a clear pattern for girls: one or the other of the parents became strongly involved with the daughter who reciprocated this emotional attachment. While boys showed the same direct

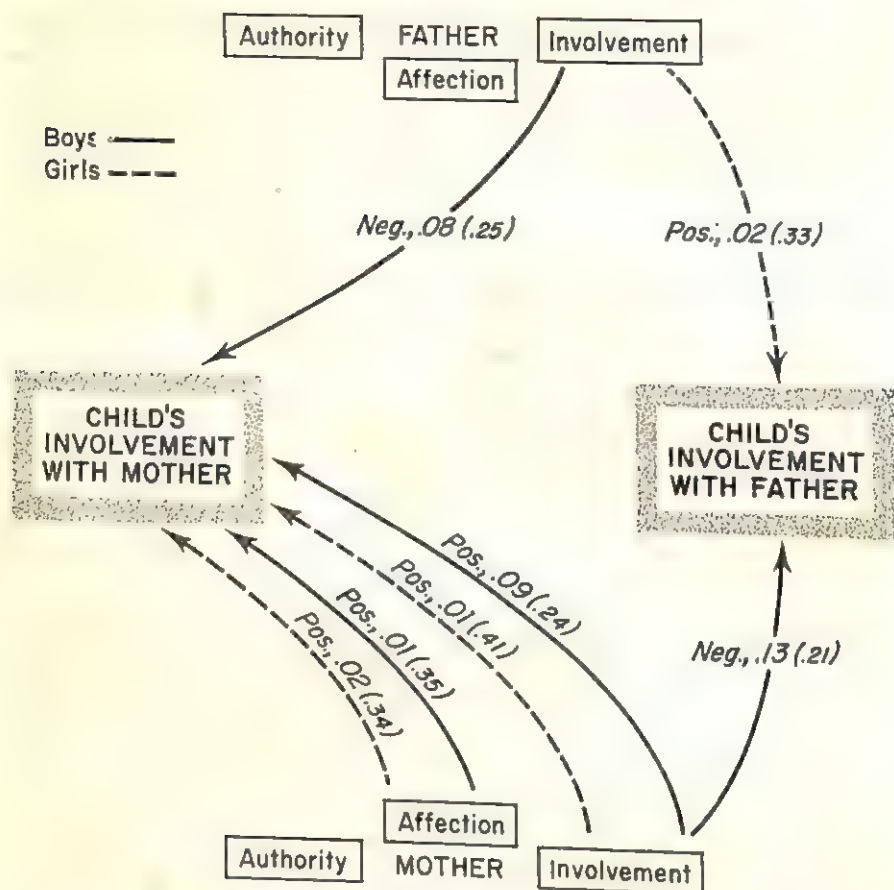


FIGURE 1
INTERCORRELATIONS AMONG PARENTAL BEHAVIORS AND THEIR RELATIONSHIP
TO CHILDREN'S INVOLVEMENT

Tests of association were made by the chi-square approximation (with continuity correction). Listed with each vector is the significance level of the association and, in parentheses, the corresponding contingency coefficient (maximum possible value = .71).

response to the mother's affection and interest, their involvement with the father seems to have been affected by some interplay among the family members, a suggestion that will be developed later on following presentation of data on involvement patterns.

Before moving on to these, a brief digression along a line of possible difference between involvement and identification may be useful. Social-learning theory argues that boys are more likely than girls to identify with the same-sex parent, and the evidence for this sex difference is rather clear-cut. It is

detectable even in preschool children (5), and our data on involvement show the same tendency. In this respect, the two concepts bear an operational resemblance. A recent text offers the generally accepted social-learning theory explanation for this phenomenon: it is due to "the fact that girls perceive the father as more powerful than the mother, and are, therefore, more ambivalent about choosing the mother as a model for identification than are the boys about choosing the father" (12, p. 273). Bandura and Walters (1) present an impressive array of evidence for the role of power in facilitating identification, a relationship that they regard as mediated by the tendency of children to imitate powerful figures.

Our data offer no support for such a mechanism in the development of involvement with parents. In the earlier paper (4), it was reported that mothers were significantly more often High in authority than fathers toward both their sons and daughters. If parental authority is an index of parental power, the power-identification hypothesis would predict that boys, rather than girls, should be put in the ambivalent situation, since the lesser power of the father would hinder a clear-cut and exclusive identification with him. Our results, of course, show the reverse. In any case, Figure 1 showed that authority played no direct part in the determination of involvement by either sex of child with either parent. However, we shall later report evidence that authority may be relevant to a particular involvement pattern.

2. Patterns of Parental Behavior in Involvement Groups

The dichotomized rating of a child's involvement with each parent generated four possible involvement patterns: High involvement with both parents, High involvement with one parent and Low with the other, and Low involvement with both parents. Table 2 presents the number of children in each of these involvement groups. Since only families for whom all ratings could be made were considered in this analysis of involvement groups, the original 100-family sample was here reduced to 44 boys' and 45 girls' families. Because an equal

TABLE 2
FREQUENCIES OF PATTERNS OF CHILDREN'S INVOLVEMENT WITH THEIR PARENTS

Group	Father only	High involvement with		Neither	Total ^a
		Mother only	Both		
Sons	20	7	14	3	44
Daughters	11	15	17	2	45

^a Six boys and five girls have been eliminated from the original samples of 50 children of each sex on the basis of having at least one parental behavior rating missing.

proportion (about one-third) of each sex falls into the "Both" category, the earlier finding of a less clear-cut same-sex preference in girls may be attributed to a substitution of father for mother rather than to a greater sharing of girls' allegiance between the two parents.

Only a very few children fail to develop strong involvement with either parent so that, despite the provocativeness of this pattern, they defy detailed analysis. All subsequent treatments are therefore confined to the analysis of the differences, separately for each sex, between groups showing High involvement only with the father (F groups), only with the mother (M groups), and with both parents (B groups).

Three modes of presentation were employed for each sex: (a) single-variable comparisons of percentage of High ratings obtained by each parent are presented in Figures 2 and 5, (b) parent patterns where the mothers' and the fathers' ratings on each variable are considered jointly are found in Figures 3 and 6, and (c) variable patterns that present each parent's ratings on each of the three variables taken two at a time are found in Figures 4 and 7. While the three approaches are necessarily interdependent, they serve to highlight implicit interactions among parents and among variables and afford access to more subtle aspects of group differences.

We will present modal family descriptions for each of the involvement groups, which will be based upon a collation of features differentiating a given group from the other two. These sketches are simply informal readings of the summary figures to which one may refer for specific documentation of each item in our descriptions.

a. Boys' Involvement Groups.

(1). *F Group.* Twenty boys—45 per cent of the total group of boys—showed High involvement exclusively with the father. The F mother was generally authoritative and unaffectionate, although there was a fair proportion of families in which her authority was accompanied by warmth. However, her authority had an impersonal cast, since she was rarely involved with her son when she had High authority. Most frequently, and much more often than mothers in the other groups, she was rated Low on both affection and involvement.

The F fathers were rarely authoritative but were strikingly affectionate and involved, far more often than the fathers in the other two types of families, and more so than the F mothers. Thus the F family was one in which strong affection and involvement came more frequently from the father than from the mother, a pattern that most clearly discriminated it from the

other two families. The large authority differential between the parents resulted in an unmistakable mode for this group: a mother who was rated as strongly authoritative and a father who was not. In only one of the 20 F families does High authority come exclusively from the father.

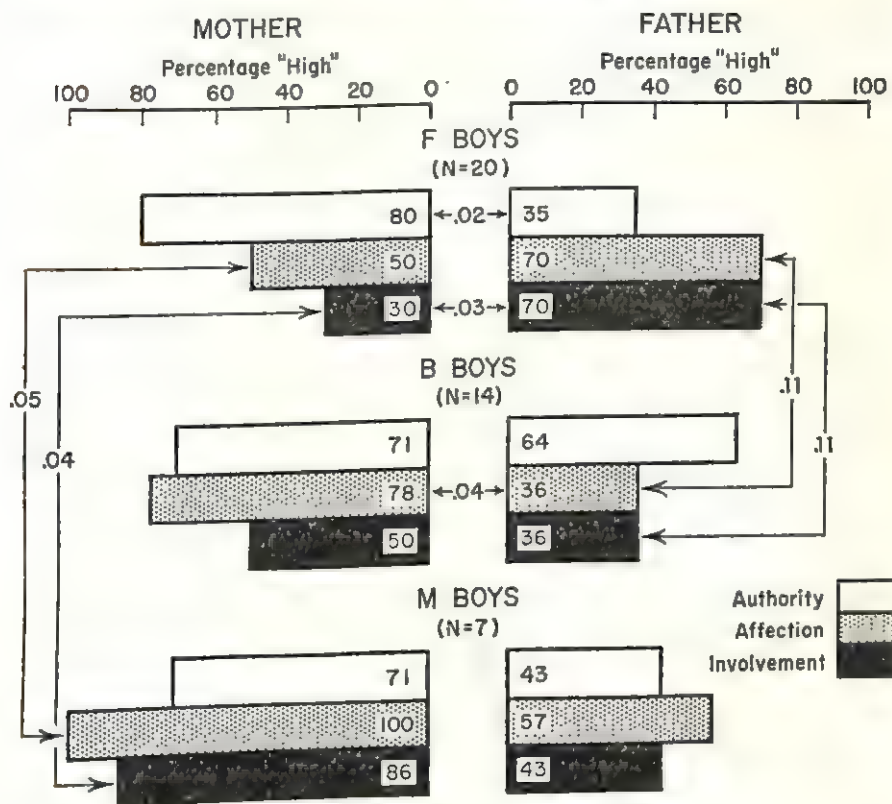


FIGURE 2

DIFFERENCES IN PARENTAL BEHAVIOR AMONG BOYS' INVOLVEMENT GROUPS

Intergroup differences in percentages of high ratings of authority, affection, and involvement for mothers and fathers were evaluated by the chi-square test. Within each involvement group, differences between mothers and fathers on each variable were evaluated by McNemar's test of difference between correlated proportions.

Summarizing these tendencies into three-variable parental types (a Low authority, High affection, and High involvement father and a High authority, Low affection, and Low involvement mother), we found that they could account for 45 per cent of the F fathers and 40 per cent of the F mothers. For the combined B and M groups, only 10 per cent of the fathers and 14 per cent of the mothers could be so described.

(2). *B Group*. High involvement with both mother and father was shown by 14 boys (32 per cent of the total group). On the whole, the B mothers were authoritative, affectionate, and not very involved. They were most easily described, not by a set of distinctive characteristics, but by their generally intermediate position with respect to F and M mothers.

By contrast, B fathers presented a pattern unmistakably different from other fathers; they were not often highly affectionate nor involved. Most differentiating was the infrequency of the Low authority-High affection involvement patterns. This near absence of warm, involved, and unauthoritative B fathers was in sharp contrast with the F and M groups where the role was typical. The mother-father authority differential in the B group was the smallest obtained; since the percentage of High authority mothers was essentially the same in all three groups, this was due primarily to the B fathers' unusually frequent exercise of strong authority. Thus, of families with a Low authority mother and a High authority father—a rare pattern exhibited by only six families in our sample—four were found in the B group, with one each in the other two groups. Another typical pattern was of an affectionate mother and an unaffectionate father. In no instance was the father High in affection when the mother was not.

The B family pattern evokes the image of the "traditional" family where the father sternly dispenses discipline while the mother remains the major source of affection. This pattern (High authority father, High affection mother) was found in 57 per cent of the B families; among the combined F and M families its incidence was 22 per cent.

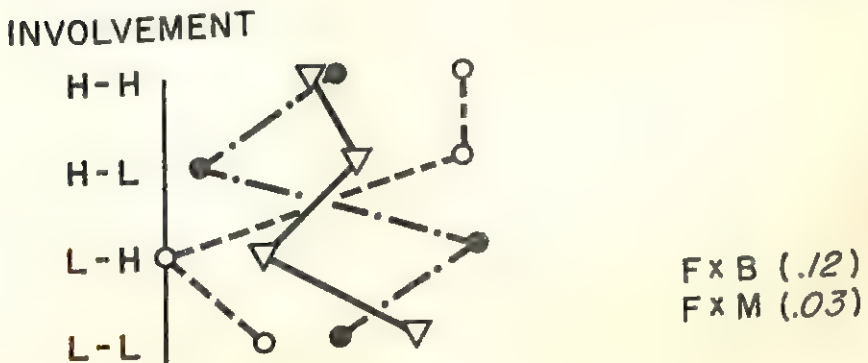
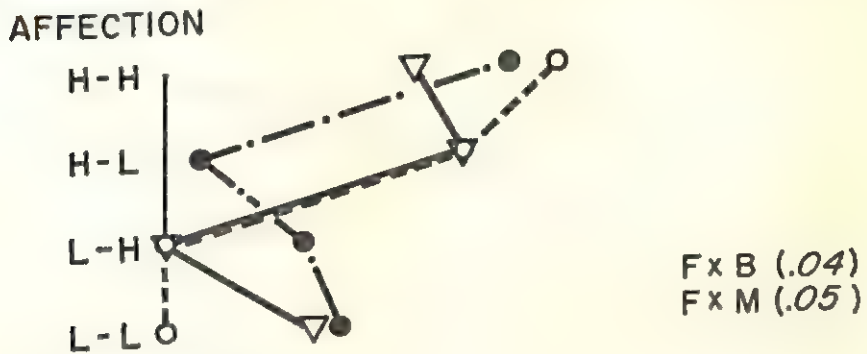
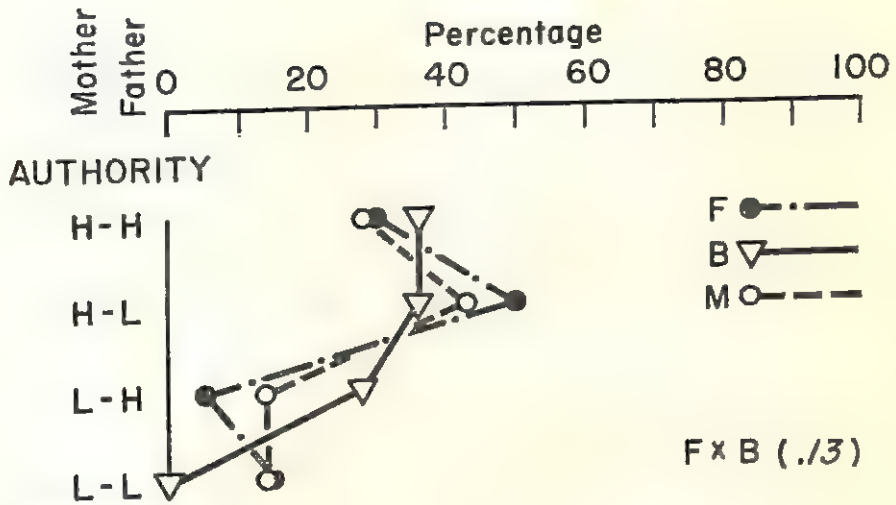
(3). *M Groups*. Seven boys—16 per cent of the total group—showed High involvement only with the mother. The most suggestive point for this, the smallest of our groups, is that all M mothers were highly affectionate and all but one were highly involved with their sons. Although the M fathers did not seem to differ in any important respect from other fathers, the unusually strong impact of the M mothers permits the inference that in this family constellation the fathers assumed, or were assigned, a background role.

To review, the three types of boys' families may be briefly sketched: F

FIGURE 3
PARENT PATTERNS ON AUTHORITY, AFFECTION, AND INVOLVEMENT
IN BOYS' INVOLVEMENT GROUPS

The plots present the percentage of cases in each involvement group who fell within each of the four categories of joint ratings of mother and father on a given variable: High-High, High-Low, Low-High, and Low-Low. Intergroup comparisons of profiles within each section were made by the chi-square test for 2×4 contingency tables.

BOYS



BOYS

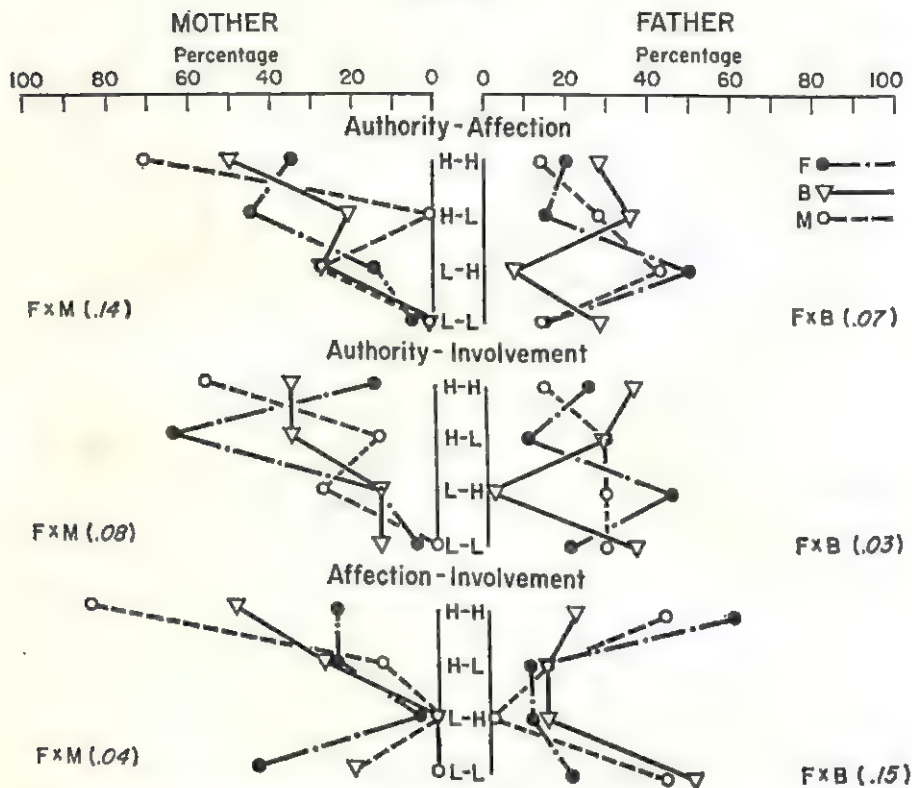


FIGURE 4

VARIABLE PATTERNS FOR MOTHERS AND FATHERS IN BOYS' INVOLVEMENT GROUPS

The plots present the percentage of boys in each involvement group who fell within each of the four categories of joint ratings of variables taken two at a time: High-High, High-Low, Low-High, and Low-Low. The order of the ratings within each category was determined by the order of the variables within the section title. Intergroup comparisons of profiles within each section were made by the chi-square test for 2×4 contingency tables.

families with a strong, perhaps stern mother and a warm father who maintained a friendly, possibly "pal" relationship with his strongly involved son; B families where the son's close bond to both parents may have been attributable to the "traditional" distribution of authority and nurturant roles in the family; and M families where the mother may have won exclusive allegiance from her son through her own high levels of affection and involvement.

b. Girls' Involvement Groups.

(1). *F Group.* High involvement with father only was shown by 11 girls (24 per cent of the total sample). The most immediately striking

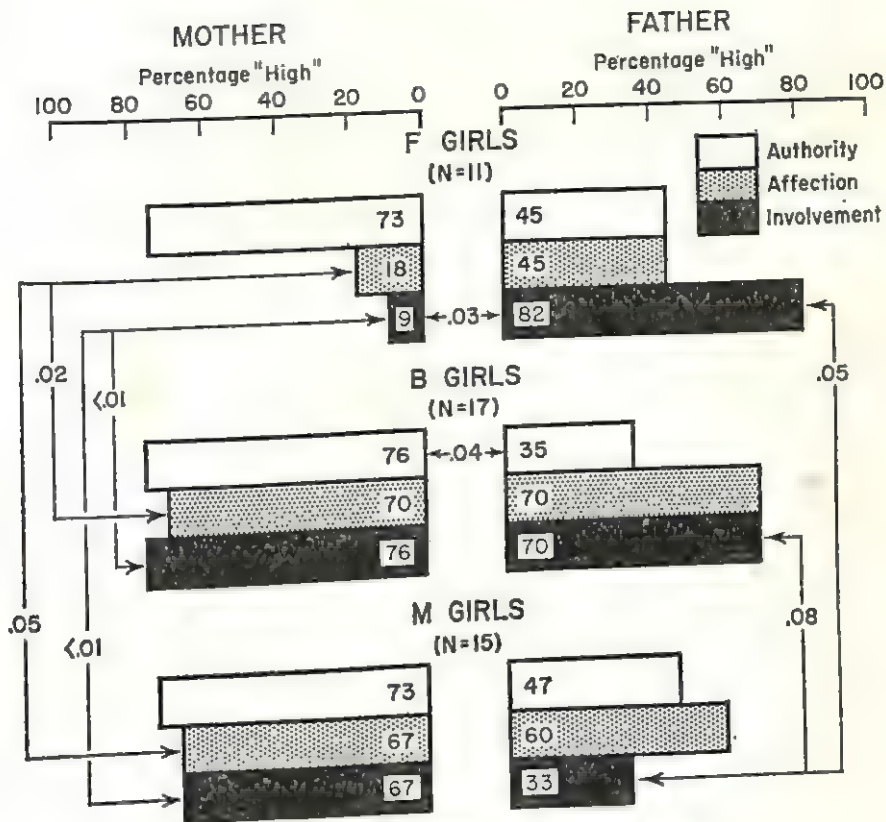


FIGURE 5

DIFFERENCES IN PARENTAL BEHAVIOR AMONG GIRLS' INVOLVEMENT GROUPS

Intergroup differences in percentages of High ratings of authority, affection, and involvement for mothers and fathers were evaluated by the chi-square test. Within each involvement group, differences between mothers and fathers on each variable were evaluated by McNemar's test of difference between correlated proportions.

characteristic of these F families was the extremely large percentage of mothers who were neither affectionate nor involved. Being Low on both affection and involvement was the modal pattern for these mothers (73 per cent of the group) and, in sharp contrast to B and M mothers, no F mother was simultaneously High on both these variables. Thus F daughters were most frequently confronted with mothers who exercised strong authority but who rarely accompanied it with either warmth or involvement. In the relatively few F families where the mothers did show a high degree of affection or of involvement, they never failed also to adopt a strong authority role.

The F fathers were strongly involved with their daughters—much more so than the fathers in the other two groups. However, compared to the latter,

they were least often affectionate. Most often they were both authoritative and involved. Furthermore, they were never strongly authoritative without also having been highly involved with their daughters. The frequency of High involvement and Low affection shown by F fathers—and the fact that this pattern was almost nonexistent in the other two groups—qualifies the earlier total-group finding (see Figure 1) that fathers' affection was unrelated to daughters' involvement. This overall lack of relationship was largely due to behavior peculiar to F families; since, when they were eliminated from the total sample of girls' families, a positive relationship between a father's affection and his daughter's involvement with him is suggested ($p = .08$, $C = .30$).

We propose that F girls became highly involved with their fathers when their mothers offered very little emotionally to them. The fathers, although very often highly involved, showed relatively little affection toward their daughters. The special quality of the F fathers' involvement suggests that it may have derived more from duty than from devotion, perhaps in an attempt to fulfill parental responsibilities neglected by the mothers' withdrawal from their daughters.

(2). *B Group*. High involvement with both parents was shown by 17 daughters (38 per cent). The mothers in this group obtained consistently large percentages of High ratings on all three variables, a fact directly reflected in the modal position of the High-High category in all three variable patterns. It is clear that the B mother was characteristically authoritative, warm, and involved.

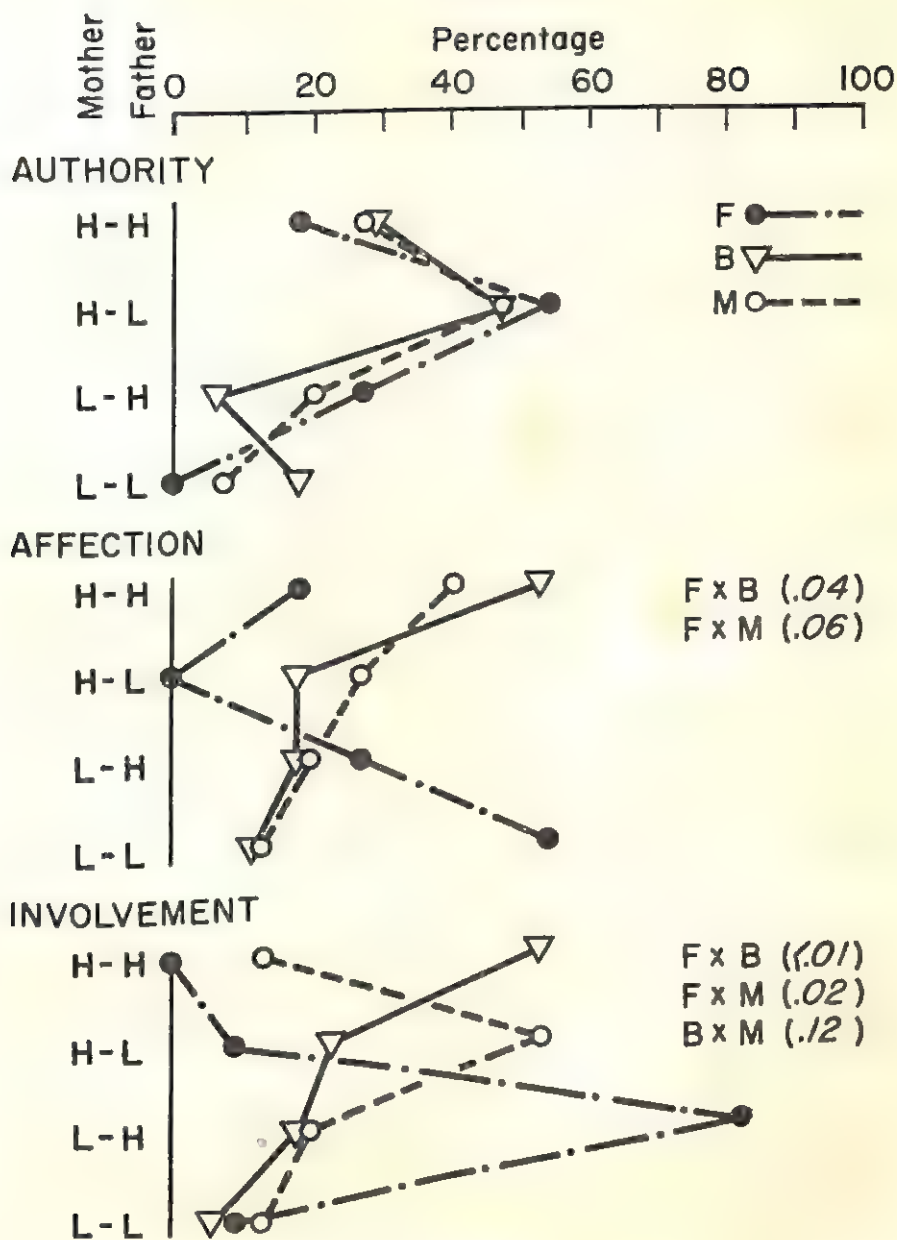
The B father was as highly affectionate and involved as his wife; however, he was far less often described as strongly authoritative. Generating the single three-variable pattern that summarizes the description of a nonauthoritative, warm, and interested father—Low authority, High affection, and High involvement—we found that it indeed defines a role almost reserved to B fathers. Seven of 10 fathers with this pattern were of B girls.

The distinguishing characteristic of the B families, then, was the high level of affectionate interest that both parents showed to the daughter. The mother, far more frequently than the father, was the disciplinarian; however, in view

FIGURE 6
PARENT PATTERNS ON AUTHORITY, AFFECTION, AND INVOLVEMENT
IN GIRLS' INVOLVEMENT GROUPS

The plots present the percentage of cases in each involvement group who fell within each of the four categories of joint ratings of mother and father on a given variable: High-High, High-Low, Low-High, and Low-Low. Intergroup comparisons of profiles within each section were made by the chi-square test for 2×4 contingency tables.

GIRLS



of the frequency with which she is described as affectionate and involved, it is very unlikely that the discipline was harsh or demanding. The general atmosphere appeared a benevolent one.

GIRLS

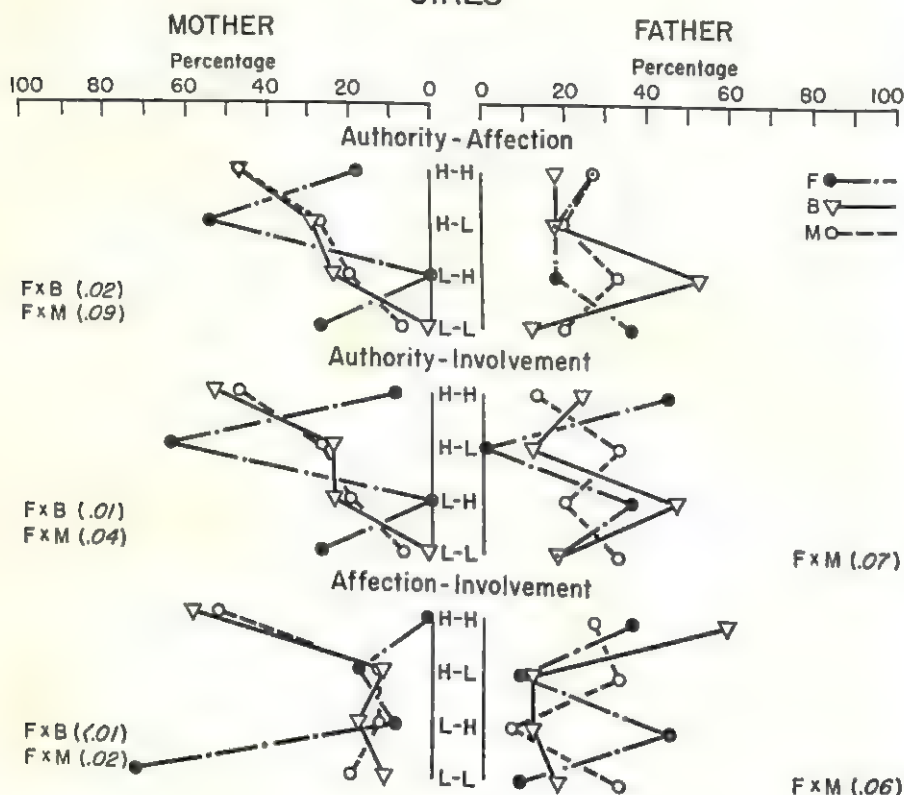


FIGURE 7

VARIABLE PATTERNS FOR MOTHERS AND FATHERS IN GIRLS' INVOLVEMENT GROUPS

The plots present the percentage of girls in each involvement group who fell within each of the four categories of joint ratings of variables taken two at a time: High-High, High-Low, Low-High, and Low-Low. The order of the ratings within each category was determined by the order of the variables within the section title. Intergroup comparisons of profiles within each section were made by the chi-square test for 2×4 contingency tables.

(3). *M Group*. The 15 girls who were highly involved exclusively with the mother comprise 33 per cent of the total group. The mothers in the M families were very similar to the B mothers; they too showed large percentages of High ratings on all three variables and were most often described as authoritative, warm, and involved. The difference between the two families is

attributable to the M father, whose level of involvement with the daughter was rated Low more frequently in the M group than in either of the other two groups. In comparison with the B father, the M father was more likely to be authoritative and less likely to have been involved. Characteristically, the M father was either highly affectionate and uninvolved or rated Low on both of these variables. Thus, in the M family, the mother was strong, affectionate, and interested in her daughter; the father, although affectionate, was comparatively distant.

Three different family situations emerge from our descriptions to date: the F family in which the mother was rejecting and the father took over the responsibility for the child who, in turn, became highly involved with him; the B family in which both parents were centered, perhaps dotingly, upon the daughter and she upon them; and the M family in which an affectionate father's comparative lack of involvement with his daughter may have led her to become strongly involved only with her affectionate and interested mother.

D. DISCUSSION

These results—both from total-group and involvement pattern analyses—suggest many possible directions for theoretical and empirical elaboration. Our choice here is to trace the heuristic effects of our decision to adopt absolute rather than relative measures of the intensity of a child's emotional ties to his parents. This procedure permitted the study of the two-dimensional involvement patterns of involvement: i.e., the F, B, and M families. Although there have been a vast number of indices for evaluating this aspect of the child-parent relationship (usually under the rubric of identification), the critical variable has uniformly been the *difference* between the child's felt closeness to his mother and father. Heilbrun's recent detailed analysis of problems in the measurement of identification (8) continues the tradition. He goes further and explicitly rejects the assessment of absolute levels of involvement with each parent as a task defying reliable judgment. His proposed Identification Scale is intentionally ipsative and has as its basis forced-choice judgments between mother and father. The index resulting from this, or any other, relative measure is necessarily univariate. Perhaps this is because the more common views of identification carry the connotation of an exclusive, or at least predominant, choice of one parent or the other. Involvement, for us, seemed free of this implication.

Our initial total-group correlational analysis, summarized in Figure 1, was, of course, univariate and Low involvement with one parent might be read as High involvement with the other. In this sense, these total-group

results invite comparison with the consensus of research employing relative measures of child-to-parent involvement or identification. This research agrees most consistently on a link between parental nurturance and a child's identification [e.g., (13)] and this association is crucial to such divergent theoretical notions as Freud's "anaclitic identification" (6) and Mowrer's "developmental identification" (11). The present data support this generalization with respect to the behavior of the mother; her affection and involvement with her child—each aspects of nurturance—predict the formation of a strong emotional tie with her by both sons and daughters.

This total-group analysis, however, said little of the correlates of involvement with father. However, results from the boys' involvement groups made the contribution of the father's behavior toward the development of involvement more comprehensible. In brief, both F and M boys followed the nurturance principle, becoming highly involved only with the more nurturant parent. B boys, in contrast, went beyond this principle by developing strong ties with both parents, although the mother was the primary nurturant figure. The father stood rather as the symbol of authority. Here, at the risk of giving short shrift to a complex theory, we may account for the B boy's strong involvement also with his father by Freud's concept of "defensive identification," (7) which he proposed as a method for resolving the Oedipal conflict. This Oedipal situation, while (for Freud) theoretically universal, seems most likely to have arisen in the "traditional" strong-father, warm-mother family setting of the B family.

This notion that families may be graded on their potential for stimulating Oedipal conflict was put forth by Peskin (14) who, working with this same longitudinal sample, successfully predicted differentiating personality characteristics for children from families varying in this potential. (In his study, the affectional patterns among mother, father, and child defined the potential: e.g., a family in which the mother was more affectionate to her son than to her husband was classified as "Strong Oedipal.") In the present study, the pattern of parents' behavior toward their child permits another means of estimating the potential for such conflict. Our characterization of the B family as strongly Oedipal is strengthened by the additional data that the relationship between the mother and father in B families is a highly compatible one ($p = .03$).⁵ In this situation, the B boy should, by psychoanalytic theory, attempt

⁵ A composite index of marital adjustment was constructed to include ratings of general marital happiness, sex adjustment, and parents' warmth toward each other. The four separate variables included in this mean composite, each assessed by two independent raters when the study child was about 4 years old, had an average intercorrelation of .69. The comparison reported is between B families' marital adjustment and that of F and M families combined.

to resolve the Oedipal conflict by bowing out of the competitive picture through developing a "defensive identification" with his father. A corollary of this process is the formation of a rather harsh and unbending conscience and a repressive style of control, particularly with regard to sexual impulses.

This hypothesis finds good support in personality descriptions available from a follow-up of this sample in their early thirties.⁶ B boys, or rather B men, in comparison with the remainder of the male sample, were found (from Q-sort data) to handle anxiety by repression ($p < .01$), to be very protective of others, to avoid seeing the erotic aspects of situations, and to be self-denying ($p < .05$). Also, they tended to be moralistic ($p < .10$).

This general result would not have been predicted for B families from an alternate view that regards conscience formation, like identification, as deriving from affectionate and nurturant relationships with parents [e.g. (9)], since a gross index of total parental affection (summing percentage High for the two parents) showed B families lowest among boys' families. Here, of course, the distinction between an unyielding superego and realistic moral standards may mitigate the apparent contradiction.

The case for the nurturance-conscience link is more directly challenged by consideration of one of the girls' involvement groups. B families clearly lavished affection upon their daughters from which effective socialization would be predicted by this hypothesis. The contrary is the case. Employing the same Q-sort data, we found that these girls, in adulthood, show clear evidence of inadequate conscience development. Girls from B families, in contrast with the other involvement groups, tried to "get away with" asocial behavior and were self-indulgent ($p < .01$). They were also more rebellious and under-controlled, while showing little guilt ($p < .05$). The image here is of the "spoiled child," an outcome not inconsistent, at least from lay theory, with the doting atmosphere that characterized these families.

This impression of the B family was strengthened by the additional data that they were more often than not one-child families (six of the nine "only" girls in our sample are from B families). Furthermore, we had available annual ratings of each family's "child-centeredness" (on a scale ranging from "child ignored" to "child catered to"), starting in preadolescence. Compositing these ratings over a six-year period (ages 11 to 16) into a single "child-centeredness"

⁶ The adult follow-up of the Guidance Study sample was supported by USPHS Grant MH 06238-03 and a Ford Foundation grant. The Q-sort data are from a related project in progress under the direction of Dr. Jack Block and Norma Haan and represent composite assessments (by at least two independent judges) based on interview material. The California Q-set of items (2) was used. Of the 100 items in this instrument, only those judged to relate to conscience or control were included for the group comparison. The Block-Haan work was in part supported by USPHS Grant MH 05300-06 and will be reported in detail in a forthcoming volume, *Ways of Personality Development: Continuity and Change from Adolescence to Adulthood*.

score, we found that B families were clearly higher than the others in catering to their children ($p < .001$).

Since the combination of these characteristics suggested that B families might tend to be better educated and upper-middle class, comparisons were made among the involvement groups on Warner's Index of Status Characteristics (16) and on mothers' and fathers' education. For none of these were intergroup differences significant, nor, incidentally, were they for the boys' involvement groups.

Thus the same involvement pattern—a strong tie to both parents—generates a striking sex difference in adult conscience, a difference with possible relevance to current theories of moral development. However, our primary intent has been to document the usefulness of the concept of involvement and the particular advantage of involvement patterns over unidimensional indices. Further work is underway in which we are exploring in detail a number of aspects of the adult functioning of the involvement groups. Included are their self-images, their perceptions of similarity to their parents, and their actual behavior as parents with their own children. Differential predictions hinging on involvement pattern are easily suggested. For example, although F and B boys were both highly involved with their fathers, it seems clear that there were qualitative differences in the nature of their ties. For one thing, we expect that their perception of and performance in the masculine role will differ, partly in response to the very different models afforded by their fathers.

We have left much unanswered, not least the question of the legitimacy of the distinction we have chosen to make between involvement and the more familiar concept of identification. Our initial, and highly general, hypothesis that a child's involvement pattern may be linked to his family milieu has support from the present data. Its adequate testing, however, must await the results of the further work in progress.

E. SUMMARY

The effect of three aspects of mothers' and fathers' parental behavior (the exercise of authority, the giving of affection, and the emotional investment of the parent in his child) upon the intensity of a child's emotional involvement with each of his parents has been investigated in a sample of 50 boys' and 50 girls' families. Ratings of these variables, for each parent separately, were based upon the full case records of a longitudinal study and represent summary clinical characterizations of the family situation as it was observed from early childhood to late adolescence.

The most general result, from a first-order analysis of correlations between child's involvement level and parental behavior, was that a high level of maternal affection and involvement was directly related to the child's developing a strong involvement with the mother. This was true for both sexes, but only the daughter is similarly responsive to the father's strong involvement.

Further analysis explored differences among families classified on the basis of the child's involvement pattern: High involvement only with father (F families); only with mother (M families); and with both parents (B families). Distinctive family sketches were inferred from these comparisons, which led to predictions concerning other aspects of the family atmosphere. Also, follow-up data available at early adulthood for this sample permitted the testing of certain predictions regarding adult personality outcomes, with particular regard to the influence of parental behavior upon conscience development.

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STIMULUS COMPETITION AND CATEGORY USAGE IN NORMAL CHILDREN* 1, 2

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A. INTRODUCTION

A considerable body of research has demonstrated that as children grow older there is a fundamental change in the manner in which they group, select, and match objects with one another (1, 3, 4, 6, 7, 9, 12, 13, 14, 17, 19, 20). In younger children the primary basis for such behavior appears to be the noting of common stimulus properties, such as form or color. In older children functional relations or common class membership comes increasingly to be the basis upon which such responses are made (13). There has been a tendency to interpret these age-related differences in behavior as indicating that younger children do not possess class or functional categories and as a result must engage in concrete or, more correctly, stimulus determined thinking (18). A related point of view has been expressed in descriptions of persons with brain pathology (2, 5, 15, 16), whose sorting behavior has also appeared to be dominated by immediately present stimulus properties. Such patients make choices on tests of category usage not as normal adults, but as younger children do.

There is little question that the descriptions of the categorizing behavior both of children and neurologically impaired adults is accurate. However, existing evidence does not permit one to conclude that the stimulus dominated behavior occurs because the *capacity* or *ability* to make functional and class categorical choices is absent. An alternative possibility is suggested by a detailed analysis of one representative study of categorization, that of Klapper and Werner (10). These investigators used an object sorting test in which a key or index object was presented together with a number of other objects. The

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² The authors wish to express their gratitude to Mrs. Juliet Bortner and Mrs. Linda Levy for their assistance in this study, and to the educational authorities of the West Hempstead School District who made it possible to conduct this study in their schools.

at the nursery ages children made no more of such matchings than would have been expected by chance. With successive increments in age, performance came to be increasingly characterized by the making of class and functional category matches, until an asymptote for the test was reached in the third grade. When stimulus competition was eliminated (Test B), children at nursery age made a significantly greater than chance number of class and functional category matches. Such selection increased regularly with age until an asymptote for this form of the test was reached in the second grade.

TABLE 5
PERFORMANCE ON TESTS A AND B AT DIFFERENT AGES

Grade	N	Test A		Test B		Significance of difference* <i>p</i>
		Mean	SD	Mean	SD	
Nursery 1	18	3.67	1.53	4.50	1.86	n.s.
Nursery 2	30	3.27	1.93	5.30	2.22	<.005
Kindergarten	24	4.88	2.33	7.08	2.29	<.005
First	28	7.96	1.97	9.25	0.95	<.005
Second	35	9.09	1.02	9.77	0.73	<.005
Third	32	9.28	1.33	9.94	0.26	<.005
Fourth	21	9.48	0.67	10.00	0.00	<.005

* Significance is tested by Wilcoxon Matched-Pairs signed-ranks test. One-tailed *p* values are given.

When matching performances on the two tests were compared at the various ages, it was found that at all ages except Nursery 1 significantly more class and functional category matches were made under conditions of stimulus noncompetition. The mean differences in performance under the conditions of stimulus competition and its absence, of course, provide information on group trends only. Another type of analysis makes it possible to examine individual performances more closely. Of the 188 children examined, 60 obtained a score of 10, or all correct, on Test A, leaving 128 children who could exhibit improvement when stimulus competition was eliminated. Of these, 97 showed increased class and functional category matching, 19 showed no change, and only 12 showed worse performance. Thus, of the children who could improve, three times as many did so as did not. The range of improvement in score was from one to six points.

The verbal rationalizations that the children advanced to explain their choices in the stimulus noncompetitive situation clearly indicated the possession of class and functional categories. Whereas in the younger children the verbalizations in Test A referred to stimulus properties, the verbalizations in Test B were either functional or class categorical. A few examples of

responses from among many made at the Nursery 2 and Kindergarten levels may serve for illustration. When shown the red teapot as index object in Test A, several children matched it with the red pill. They rationalized this choice by saying "It's the same color." On Test B when they matched it with the saucer many responded to the question of "Why" by saying "You eat and drink coffee from them," or "You pour coffee from it to here." When given the cow as index object on Test A, one child matched it with a tiger and could only say "I don't know" when asked why he had done so. On Test B, however, he matched the cow with the hen and said "It's in a barn also." Another child, who on the Test A matched the cow to a lion and said "It looks like it," used the hen as the match on Test B and said "Lives on a farm too."

At the kindergarten level the same tendency was even more pronounced. When the metal bell was the index object in Test A it was often matched with the silver button and explained as "both metal." On Test B the church was more frequently matched to the bell and rationalized with the statement "Churches have bells." The black wheel was matched to a black box top by one child on Test A who explained his choice by saying "It's black." On Test B he chose the yellow wheel saying "They're both wheels." When the red button was matched to the red lipstick case by three of the kindergarten children on Test A, two explained their choice by saying "It's red" and the other by saying "It's round and red." On Test B all three chose the thread and in various ways indicated that one sewed buttons with thread.

Many other illustrations could be given. However, they all serve to indicate the occurrence of a major difference in response style to the two tests. This difference can best be characterized as a change from stimulus domination in Test A to functional or class category usage in Test B.

D. DISCUSSION

The findings of the present study support the view that the failure of young children to use functional or class categories as the basis for sorting behavior under usual test conditions does not stem entirely from their lack of possession of such categories. In considerable degree, such concept possession is clearly shown both in their sorting and in their verbalizations when appropriate conditions for eliciting class and functional responses are provided. The change in condition that was effectively introduced was the elimination of the opportunity to select stimulus properties as the basis for sorting. When opportunities for using stimulus properties were present, young children prefer-

patient was asked to select that one of the simultaneously presented group of objects that he believed "goes with" the key object. Characteristically, the objects from which the child had to make his selection represented an assortment in which some objects were related to the "key" in terms of functional or class characteristics, others had no apparent relationship, and the remainder resembled the "key" in terms of such stimulus properties as shape or color. Therefore, in each object sorting task the patient had four response alternatives. He could make no response, match the "key" object with an unrelated one, match it to one that was related to it by conceptual or functional features, or match to an object with a common stimulus property.

In our view, the child was not being asked merely to exhibit his ability to use a class or functional category, but to use such characteristics in preference to stimulus attributes. It may, therefore, be argued that in young children the capacity to engage in category usage may be present, but that there is a preferential selection by them of stimulus properties over class and functional characteristics when both sets of attributes are simultaneously available in the presented task. Such an interpretation suggests that, when the materials presented contain both class and stimulus opportunities, the selections made reflect the prepotency of responsiveness to the stimulus factor rather than any true lack of the ability to use functional or class attributes. From this standpoint the sorting task is one in which stimulus properties and functional or class attributes *compete* for the child's attention. The capacity to use functional and class attributes may exist, but need not be expressed in sorting behavior on the usual tests because of the prepotency of the stimulus properties in determining the behavior.

The present investigation was designed to test the hypothesis that preferential responsiveness to stimulus factors and not the failure to possess class and functional categories underlies the failure of young children to make categorical choices. Testing this hypothesis required the design of a sorting test having two forms. In one of these, stimulus competition was present. In the other, stimulus competition was eliminated. Thus the performances of the same subjects under conditions of stimulus competition and its absence could be compared. The present study reports such a comparative analysis of the sorting behavior of normal children between 3 and 10 years of age.

B. SUBJECTS AND PROCEDURE

The characteristics of the 188 children studied are summarized in Table 1. They ranged in age from 3 to 10 years and were all pupils in either nursery or elementary school. No mentally subnormal children were present in the

group and overall intellectual level was bright normal. *IQs* were obtained by means of the Peabody Picture Vocabulary Test in the preschool and kindergarten children and with the Otis Quick-Scoring Mental Ability Test in the remaining groups.

TABLE 1
DESCRIPTION OF SAMPLE OF CHILDREN STUDIED

Grade	<i>N</i>	<i>IQ</i>		<i>MA</i>		<i>CA</i>	
		Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>
Nursery 1	18	108.61	9.78	4.28	0.65	3.63	0.17
Nursery 2	30	109.83	10.77	5.63	1.01	4.50	0.26
Kindergarten	24	115.67	12.58	6.25	0.64	5.42	0.26
First	28	123.75	13.51	7.66	0.87	6.20	0.31
Second	35	125.17	12.34	9.16	0.88	7.32	0.29
Third	32	120.25	12.29	9.93	0.90	8.28	0.32
Fourth	21	112.48	9.83	10.56	0.95	9.39	0.30

Each child was tested individually and given two sets of tasks. These are presented as Tests A and B in Table 2. On every task in both tests, the child was required to match an index object with one of a group of three choice objects. Tests A and B had identical index and available class or functional choice objects. They differed in that in one case (Test A) the remaining two choice objects resembled the index object in either color or form, whereas in Test B the noncategorical choices did not share any obvious stimulus property with the index object. Thus in Test A the child, when he made a categorical choice, did so in the presence of stimulus competition, whereas in Test B such competition had been systematically eliminated. Each test contained 10 items and the positions of the categorical choice objects were varied systematically. Positional placements are indicated in Table 2 where *a*, *b*, and *c*, refer respectively to positions from left to right.

The testing proceeded as follows: The index object and the choice objects were placed before the child with the index object nearest to him. The child was permitted to inspect the objects and their names were given him by the examiner. The child was then asked to choose the object that "goes best" with the index object. After he made a choice he was asked, "Why do these go together?" Both the choice and the verbal response were recorded.

All subjects were given Test A first and then Test B. This was necessary, since Test A contained all competitive distractor items and Test B all non-competitive distractor items. Thus, if Test A were given second, the "pull" of the competitive stimulus properties might have been vitiated by the prior experience with Test B. Since it was possible that better performance on Test B could derive from experience with Test A, two additional groups

TABLE 2
MATCHING TESTS A AND B

Test A and B Index objects	Test A Stimulus competition choices	Test B Stimulus noncompetition choices
1. Metal bottle top	a. metal spring b. <i>cork*</i> c. red disc	a. clothespin b. <i>cork</i> c. card
2. Ink bottle with red and white label	<i>white bottle</i> sunglass lens red and white match box cover	<i>white bottle</i> candle brush
3. Metal bell	thimble <i>toy church</i> silver button	cigar <i>toy church</i> pliers
4. Red teapot	pipe bowl with half stem red pill <i>saucer</i>	bow tie key <i>saucer</i>
5. Black rubber wheel	Stick <i>wagon wheel</i> black round box top	fish <i>wagon wheel</i> small box
6. Red button	blue poker chip <i>thread</i> red lipstick case	blue nut <i>thread</i> cup
7. White plastic hat	<i>red glove</i> white box red dome	<i>red glove</i> ABC block eraser
8. Hourglass	<i>wristwatch</i> whiskey glass diaper pin	<i>wristwatch</i> pipe lock
9. Yellow lady	<i>white man</i> yellow ape blue clothespin	<i>white man</i> car bulk
10. Cow	lion tiger <i>hen</i>	scissors checker <i>hen</i>

* Italicized objects were scored as categorical choices.

of subjects matched for age and *IQ* were studied. One of these groups received Test A only and the other Test B only. The differences in scores that were obtained between Tests A and B were the same as those found when children were given both tests. An improvement on Test B in the main study, therefore, does not reflect an experience effect.

Using the Kuder-Richardson formula on the entire sample of 188 children, the reliability of Test A was 0.86 and of Test B, 0.86.

C. RESULTS

As may be seen from Tables 3 and 4, the choices made by the children on both Tests A and B exhibit clear developmental trends. Not only is there a general increase in the number of children in successive age groups who tend to make matching selections on the basis of class or functional charac-

TABLE 3
PERCENTAGE OF CLASS OR FUNCTIONAL CATEGORY RESPONSES MADE
ON TEST A ITEMS AT DIFFERENT AGE LEVELS

Item	Per cent of children in each grade						
	Nursery 1	Nursery 2	Kinder- garten	1	2	3	4
1	44	40	71	79	97	94	90
2	50	50	46	82	91	97	95
3	28	43	58	75	89	84	100
4	39	40	63	86	100	94	100
5	67	50	67	93	91	100	100
6	22	33	46	82	83	88	95
7	17	17	25	64	80	84	90
8	44	17	21	82	91	100	95
9	33	20	63	86	100	97	95
10	22	17	29	68	86	91	90

TABLE 4
PERCENTAGE OF CLASS OR FUNCTIONAL CATEGORY RESPONSES MADE
ON TEST B ITEMS AT DIFFERENT AGE LEVELS

Item	Per cent of children in each grade						
	Nursery 1	Nursery 2	Kinder- garten	1	2	3	4
1	56	70	79	96	97	100	100
2	44	63	71	89	97	100	100
3	44	57	50	96	94	100	100
4	44	70	88	100	100	100	100
5	61	57	88	93	97	100	100
6	61	60	83	96	100	100	100
7	22	27	58	89	94	94	100
8	22	23	50	96	100	100	100
9	28	47	54	71	97	100	100
10	67	57	88	96	100	100	100

teristics, but a similar trend is notable for each item of both tests. The younger the child the more likely is it that matching will be to stimulus similarity. The older the child the more frequent the use of class and functional attributes.

The number of class or functional category selections made under the conditions of stimulus competition and its elimination for each of the age levels are presented in Table 5. Under conditions of stimulus competition (Test A),

entially used stimulus identity or similarity as the basis for sorting. In the absence of such opportunities a significant increase in functional and class category choices occurred. These choices were not arbitrary or a mere function of the inappropriateness of the other available choice alternatives. The children not only made choices on the basis of class category or functional relatedness but verbalized these in an appropriate manner.

The findings provide support for the view that young children have the capacity to react both to stimulus and to class or functional attributes of objects. However, when both sets of properties are simultaneously present in the objects to be sorted, stimulus features are prepotent in the organization of the response. In this sense, then, stimulus attributes compete successfully against functional and class properties and are the compelling aspects of the situation in which a choice is being made. As the developmental trends indicate, such stimulus domination diminishes with age and comes to be replaced by an increasing tendency to be responsive to functional and class features of relatedness.

It is of interest to explore the implications of our findings for the sorting behavior of brain-damaged persons. These findings suggest that the stimulus dominated sorting behavior of such patients (5, 18) may be due not to a loss of the capacity to use class or functional categories but to a change in the effectiveness of such features of the objects in guiding behavior. The frequently noted tendency to respond preferentially to stimulus as contrasted to class and functional attributes can then be viewed as the result of the reordering of the hierarchy of response selections to features of the environment that may occur as a result of cerebral injury (8, 11).

Starting from this approach we can hypothesize that disturbances in categorical functioning might equally readily be considered to be the product of the reorganization of the hierarchy of cognitive levels in cerebrally damaged patients. Concretely, we are led to think that most tests of categorical functioning can be viewed as competitive situations in which both sensory and conceptual elements are available for selection. If the normal adult hierarchy is disturbed, it could result in responses based upon a predominantly sensory or stimulus-oriented set, and so artifactually create the impression of a true loss in the capacity to use categories of a functional type. This line of reasoning suggests that, when stimulus competition is eliminated, cerebrally damaged patients who in the competitive situation fail to use functional or class categories for matching may do so under conditions in which sensory competition is eliminated or made less prepotent. Studies currently in progress are designed to test this hypothesis.

E. SUMMARY

The object matching behavior of 188 normal children between 3 and 10 years of age was studied under two conditions. In both conditions the index object was presented together with three objects from among which a matching choice had to be made. In one situation the choice objects had properties that could be related to the index object either through stimulus similarity or in terms of function and class membership. In the other situation functional and class attributes, but not common stimulus features, were present. It was found that when stimulus similarities were available for choice, young children preferentially matched for these rather than for functional relations or class membership. When such stimulus competition was eliminated, many children exhibited the possession of previously unexpressed concepts of class and functional relatedness. The results are considered in relation to the problem of concept possession as contrasted with concept availability in normal and brain-damaged persons.

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A NORMATIVE STUDY OF 220 CONCEPTS RATED ON THE
SEMANTIC DIFFERENTIAL BY CHILDREN
IN GRADES 2 THROUGH 7*¹

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A. INTRODUCTION

In the course of experience with stimulus objects, none of which are identically the same, certain attributes of the stimuli are abstracted, cognitively structured, and associated with a label or other response. The acquisition and utilization of a common identifying response to dissimilar stimuli are requirements of concept formation (9). Whatever classifications are made in conceptualizing environmental events depends on the breadth and variety of experiences that determine which attributes will be abstracted as critical. In this context the development of concepts is an individual matter. Nevertheless, as a result of the similarity of experience within a given cultural setting, considerable constancy in concepts will exist among individuals.

Similarities in denotative meaning among individuals in a society are the result of socially reinforced responses made to culturally significant patterns of stimulation. One learns to use acceptable linguistic symbols for critical attributes perceived and discriminated in a variety of stimulus objects. Thus, linguistic patterns of behavior that correspond to those of the other members of the speech community are encouraged. Connotative meanings, on the other hand, are abstractions based on noncriterial attributes (1). They are regularly experienced, as are the attributes of denotative meanings, but do not receive social reinforcement. Thus, connotative meanings may vary widely among individuals.

The cognitive and affective components of individual experiences, comprising the connotative component of concepts, have been popularly indexed by the semantic differential. Relatively consistent semantic structures have been identified in cross-cultural comparisons (22). The evidence suggests that people

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among different cultures do have similar kinds of personal experiences with concepts, involving perceptual, cognitive, motivational, and emotional elements.

While several alternative theoretical positions are useful in studying meaning, Osgood's (21, 23) notion of the representational mediational processes has been important in the study of connotative meaning. Mediation in this framework requires that the stimulus be located in a continuous semantic space of meaningfulness (measurements taken by the semantic differential). The stimulus is represented as a point in semantic space rather than by the probability that a particular Stimulus-Response (S-R) chain will be elicited. The mediated stimulus is defined by the location itself and is the meaning of the concept. Any response (for example, an overt naming response) will generalize to nearby locations. A concept is attained when varying stimulus patterns, even though common attributes are not apparent, elicit a common mediating response serving as a cue for directing behavior. To the extent that several different verbal units might elicit the same sensory, cognitive, or affective response, the elicitation of common responses to different stimuli on the semantic differential implies the existence of similar mediators.

The present investigation explores the use of the semantic differentiation technique for changes in connotative meanings of concepts over the age span represented in grades 2 through 7. Although primarily a descriptive study, with the principal objective of providing normative data for further investigations, several assumptions regarding semantic differentiation are immediately apparent and were used as guides in the analysis: Some classes of concepts will be so thoroughly experienced by the time the child is in the second grade that his meanings, as indexed by the semantic differential, will correspond to those of the adult. Other classes of concepts (for example, those referring to abstract events) will have been little experienced in the second grade, with the result that they will have little or no meaning. The meanings of these concepts will gradually approach those of the adult speech community over the age span represented in the elementary school. In addition, the location of concepts in the semantic space should correspond to individual differences identified with mental age, chronological age, sex, socioeconomic status, and the like.

Several types of analyses are available for describing concepts rated on the semantic differential. (a) Concepts can be located in semantic space by using factor scores for the most salient dimensions. This procedure yields a descriptive profile for each concept. The raw data embodied in the ratings made on 20 or more scales is reduced to a specified number of dimensions. (b) The polarization (intensity) of the rating can be used to index the meaning of a

concept. This follows from the assumption that the point in semantic space signifying "meaningless" is at the origin, or zero, on a scale of -3 through $+3$, or $+4$ on a scale of 1 through 7. Greater meaning is represented by the departure of the rating toward the extreme ends of the scale. (c) The distance between profiles of concepts within a grade, or profiles of a single concept between grades, or any other classification of groups, can be indexed. Any one, or all, of the procedures might be applied to discover the extent to which similar connotative meanings are shared by different concepts, or the extent to which connotative meanings of a single concept are shared by different groups. Smaller distances imply parallel experiences. Neither the technique of semantic differentiation nor these analytic procedures enable the investigator to characterize all classes of meanings necessary to the understanding of the head meanings of concepts. Whatever procedures are used necessarily depend on the hypotheses tested. However, the present analyses are intended to suggest the several avenues available for use of the semantic differential (SD) in further explorations of the development of connotative meaning, in relating it to other associative techniques, and in the study of mediation and transfer.

B. METHOD

1. Procedure

The data for this study were collected in conjunction with a factor analytic study (2) of the development of meaning. That study, in turn, was preceded by an adjective elicitation study (3, 4) to identify modifiers used by children in the grade levels involved. The procedures, Ss, and scales have been described in detail in the reports of those studies. Briefly, the data were collected under three different conditions as follows. *Study I*: 20 concepts were rated on 37 scales by 100 children in each of the grades from 2 through 6. Each S rated all 20 concepts. *Study II*: 100 concepts were rated on 27 scales by children in grades 2 and 3, and an additional six scales by children in grades 4 through 7. Each concept was rated by 20 Ss in each grade. *Study III*: An additional set of 100 concepts was rated by children in grades 3, 5, and 7 on 21 scales. Each concept was rated by 20 to 30 Ss in each of the grades.

The scales used in all studies were based on adjectives selected from responses in the word-association task according to the criteria of frequency of usage, diversity of usage, and independence of meaning. Different groups of children were used in each study.

In Studies I and II, children in grades 2 and 3 were individually instructed how to use the semantic differential. The Ss in the remaining grades were instructed in classroom groups. Ratings of concepts were administered by the

teachers of each grade over a three- to four-week period under periodic supervision of a graduate assistant. This procedure was followed, since it was believed that rating more than two or three concepts at a time would be too tiring for the younger *Ss* and might result in careless ratings. However, since only 21 scales were used in Study III, the ratings were made within two or three class periods of about 35 to 40 minutes each, on consecutive days. All groups in Study III were given group instructions and the concepts were administered by the investigator with the assistance of a graduate assistant and teacher. One major change in instruction was made in Study III, which is of importance in interpreting the data. For that study, *Ss* were instructed that while the midpoint of the scale could (and should) be used where necessary, they were to attempt discriminations involving the remaining scale-positions insofar as possible. The latter procedure had been used by Small (26) and, subjectively, appeared to be as effective as the more prolonged period and less restrictive instructions used in the first two studies. The author's impression is that the procedures used in Study III are to be preferred over those used in Studies I and II for further investigations.

2. Scales

All analyses presented here are based only on those scales common to the three studies, and with highest loadings on the five factors extracted in the factor analyses, as follows: Evaluative (E)—*good-bad, friendly-unfriendly*; Potency (P)—*strong-weak, brave-not brave*; Size (S)—*big-small, long-short*; Activity (A)—*fast-slow, moving-still*; and Warmth (W)—*hot-cold, dry-wet*. All summaries parallel the bipolar opposites arranged in the order shown above. A seven-point scale was used in making the ratings: the "1" position in all tables refers to an extreme rating on the left term of the bipolar opposites (e.g., *good, strong, big, fast, or hot*) and the "7" position refers to an extreme rating on the right term of the bipolar opposites (e.g., *bad, small, slow, or cold*).

3. Concepts

In Study I, the 20 concepts were selected to sample the salient dimensions (E P A) found in adult studies, and include concepts related to the self-image and sex-role. In Study II, 95 of the 100 concepts used in the Adjective-Elicitation Study were rated. These concepts were identically the same as those selected for the University of Illinois, Institute of Communications Research, Cross-cultural Study of the Generality of Meaning Systems (22). In addition, five adjectives were rated. The words rated in Study III were

samples from the Kent-Rosanoff Association Test (14), from Noble's (18) list of experimental words and from *An Atlas of Semantic Profiles for 360 Words* (11). In all studies reported here, there are represented 65 words from the Kent-Rosanoff Association Test, 14 from Noble's list, and 135 from the *Atlas of Semantic Profiles*.

4. Analysis

The analyses presented in this report are of an exploratory nature. The use of the semantic differential generates a large amount of data that may be analyzed in a number of ways. Some of the possible analyses are extensive and require considerable computer time. The most feasible approach appeared to be that of first reducing the individual scale data to a manageable form. The decision was made to sample several alternative analyses for locating concepts in the semantic space of children, thereby providing basic normative data for further studies of the mediation processes (6) and for analyses of trends in the development of connotative meaning. The data used in these analyses were mean factor scores of each concept. The *brave-not brave* scale was not used in Study I. Accordingly, the "mean" Potency factor-score for concepts in that study is based only on the *strong-weak* scale ratings.

Second, a factor analysis of the 100 concepts in Study II was made of ratings by Ss in grades 2 and 3. These analyses were made separately for each of two sets of 50 concepts called Series A and B. The basic 50×50 intercorrelation matrix consisted of Pearson product-moment correlation coefficients of scale means for each concept. This analysis provides replications by grade and by concepts in the extraction of concept clusters.

Third, the location of concepts in semantic space was indexed by the mean factor scores. Each score was obtained by combining the ratings on the two scales defining the factor, summing over individuals, and dividing by N . Where necessary, ratings were reversed to align scales on each dimension.

Fourth, the polarity of concepts was used as an indication of affective meaningfulness. The polarization of each concept was determined by the generalized formula for distance (D), $D_u = \sqrt{\sum_j d_{uj}^2}$.

Fifth, the distance between concepts and that between grades for a given concept are also measures of interest. A summary of this analysis for grade-sex groups in Study I is described in this report. Other comparisons of the distances between a small number of concepts in Studies II and III can be easily calculated from the mean factor scores by employing the generalized distance formula (23, pp. 90-93).

C. RESULTS

1. *Factor Scores*

The factor-score means² for all concepts rated by Ss in Studies I, II, and III are presented in Tables A, B, and C.³ The concepts are listed alphabetically within each table for ready reference. Factor means for concepts are grouped by grade to allow comparison of changes in ratings across grades. The data for Study I (Table A) are presented by grade-sex groups ($N = 45-55$ in each).

The most apparent observation in these data is the uniform nature of the direction of the factor scores. Rarely, for example, was a concept rated on the positive end of the Evaluation dimension by one grade and on the negative end by another grade. Few reversals in the ratings appear in the means for the remaining dimensions. Consistent trends over age from neutral to positive or negative ratings, and from the positive or negative end of the dimension to neutral were identified as noted below.

2. *Concept Locations in Semantic Differential Space*

a. *Concept locations: Graphic presentation.* One of the simplest methods of viewing concept clusters is that of graphically mapping the location of concepts in the semantic space. These models for males and females in grades 2, 3, 5, and 6 are presented in Figures 1 and 2 for the 20 concepts rated in Study I.

Each of the concepts in these figures has a projection to a point on the plane defined by the scales *good-bad* and *big-small*. The length of the projection either upward (solid line) or downward (broken line) from the plane indicates the rating on the *moving-still* scale.

In all displays the concepts are clearly located in the quadrants represented by the positions E+ P+ A+ (*friendly-big-moving*) and E- P+ A+ (*unfriendly-big-moving*). The general response tendency appears to be one in which most discriminations are made according to the Evaluation dimension rather than with regard to the other dimensions. However, discriminations are found within the space represented by the *active* (as opposed to the

² Mean values for factor scores and polarity scores are given to two decimal places. Thus, a mean of 549 is read as 5.49.

³ Tables A to K and Figures A through D, designated by letter in this report, have been deposited as Document number 9047 with the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D. C. A copy may be secured by citing the Document number and by remitting \$5.00 for photoprints, or \$2.25 for 35-mm microfilm. Advance payment is required. Make checks or money orders payable to Chief, Photoduplication Service, Library of Congress.

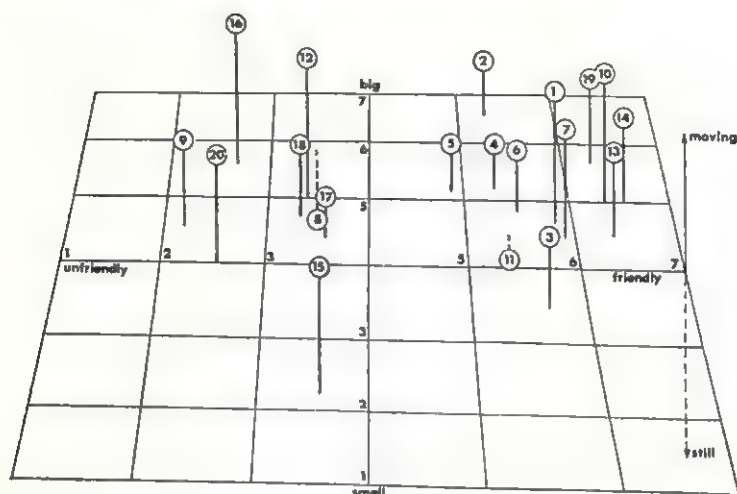
inactive) and the *big* (as opposed to the *small*) ends of the scales. The concentration of ratings in these areas appears to reflect the meanings of the concepts rather than any rating bias peculiar to children's rating procedures.

The average of the polarization ratings over all 20 concepts is distinctly related to age, although differences from one age level to the next are small. The intensity of ratings for specific concepts, on the other hand, sharply reflects an increase in magnitude over age. The most apparent trends in polarization of connotative meaning, and of the clustering of related concepts, involve social values including loyalty and patriotism. In a more general sense these are emotionally laden concepts with dominant connotative elements. Trends in changes in polarity are most apparent in a comparison of the data for the second grade males with the data for the remaining grade-sex groups. The apparent clustering and polarization of related concepts are more distinctly defined for female than for male Ss.

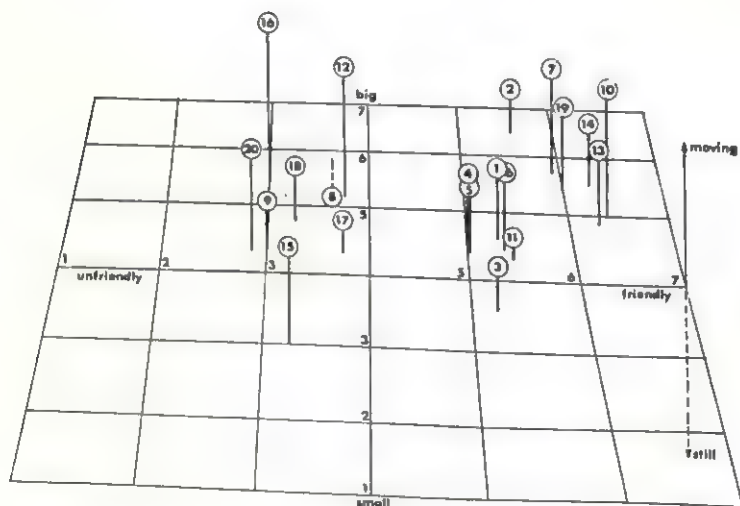
Another group of concepts is of interest, since it reflects differences in the perceptions of the sex-role. These are the ratings of *Me*, *Father*, and *Mother*. Both sexes rate *Mother* more favorably than *Father* on the Evaluation dimension and rate *Me* more like *Mother* than like *Father*. The differences in the female Ss' ratings of *Me* and *Father* are larger, in all grades, than the differences between their ratings of *Me* and *Mother*. Marked changes in the distances between *Me* and the opposite-sex parent occur between the fifth and sixth grades.

Graphic comparisons based on mean factor scores for three salient dimensions of selected concepts, between two age groups from each of the Studies II and III, are displayed in Figures A through D.

b. Concept locations: Distances. The differences in meanings among the 20 concepts rated by Ss in Study I are presented in Tables D through H. Separate tabulations are displayed for males and females in grades 2 through 6. Distances were found by the use of the generalized D_{ij} formula: that is, by taking the square-root of the summed squared differences between each of the j factor scores for i and k concepts divided by the number of dimensions. The five factor scores for Evaluation, Potency, Activity, Size, and Warmth were used in this analysis. In the tables, the larger the value of D the greater the distance between concepts. Conversely, if the D -value were zero, there would be no difference between the two concepts being compared. It will be noted that the conclusions based on analysis of the graphic presentations are, in general, supported by the data in the tables of distances. Variations between the two types of displays will be noted, however, since the graphic presentations for Study I are based only on single scales for each of the three



GRADE 2 FEMALES

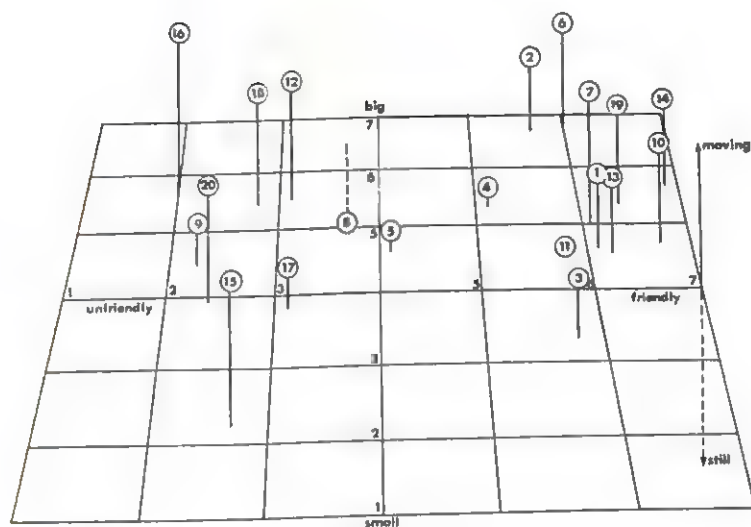


GRADE 2 MALES

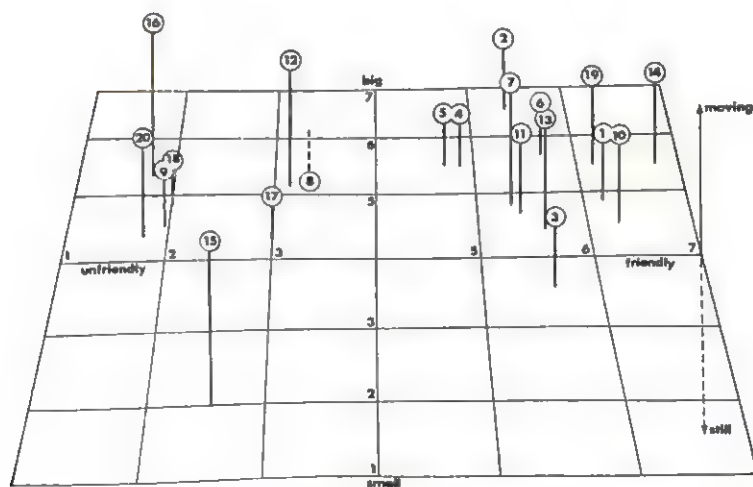
FIGURE 1

THE LOCATIONS OF CONCEPTS IN THE SEMANTIC DIFFERENTIAL SPACE DEFINED BY THE SCALES UNFRIENDLY-FRIENDLY, BIG-SMALL, AND MOVING-STILL RATED BY MALES AND FEMALES IN GRADES 2 AND 3: STUDY I

The concepts are numbered as follows: 1—Teacher, 2—America, 3—Lamb, 4—Being brave, 5—Science, 6—Freedom, 7—Me, 8—Desert, 9—Being angry, 10—Mother, 11—Music, 12—Eagle, 13—My best friend, 14—God, 15—Spider, 16—War, 17—Losing or failure, 18—Russia, 19—Father, and 20—Enemy.

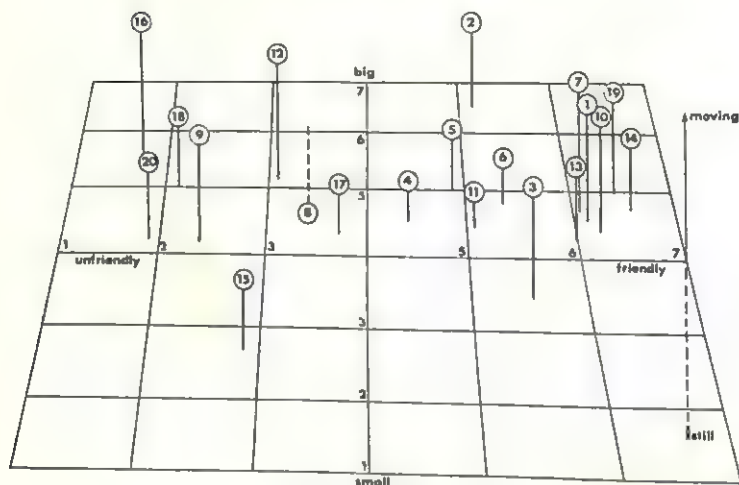


GRADE 3 FEMALES

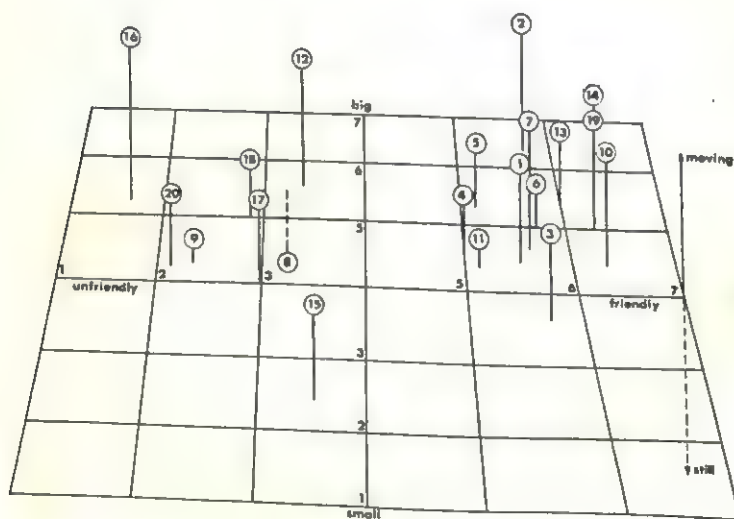


GRADE 3 MALES

FIGURE 1 (continued)

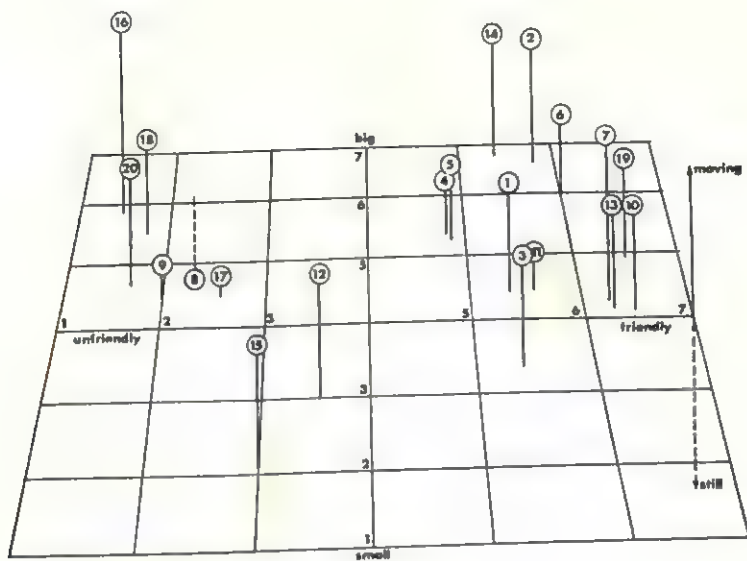


GRADE 5 FEMALES

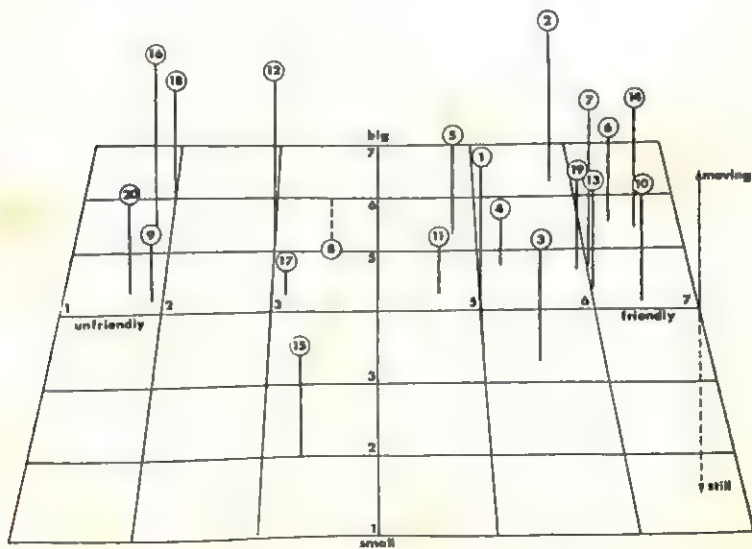


GRADE 5 MALES

FIGURE 2
 THE LOCATIONS OF CONCEPTS IN THE SEMANTIC DIFFERENTIAL SPACE DEFINED
 BY THE SCALES UNFRIENDLY-FRIENDLY, BIG-SMALL, AND MOVING-STILL
 RATED BY MALES AND FEMALES IN GRADES 5 AND 6: STUDY I
 Concepts are numbered as in Figure 1.



GRADE 6 FEMALES



GRADE 6 MALES

FIGURE 2 (continued)

salient dimensions; the values in the tables of distances involve comparisons of means for five factor scores and each mean is based on two scales.

3. Concept Clusters

The dimensions of connotative meaning are typically extracted through a factor analysis of the matrix of correlations between *scales*. This procedure yields the clusters of related scales. In the present analysis the process was reversed by factor analyzing the matrix of correlations between *concepts*. Separate analyses were made for each of two series (A and B) of concepts, rated by grades 2 and 3, in Study II. Series A consisted of 50 concepts selected to represent the eight octants of the three-factor space defined by the three salient dimensions of Evaluation, Potency, and Activity: e.g., *Horse* was in Octant I, since it was positive on the three factors (E+ P+ A+); *Chair* was in Octant II (E+ P+ A-); *Battle* in Octant V (E- P+ A+); and so on. Series B was composed of the remaining 50 concepts.

A 50×50 concept intercorrelation matrix served as the input for each factor analysis. The principal components solution was used for the initial factorization. Units were employed in the principal diagonal of the correlation matrix. After factorization, the solutions were rotated by the Varimax routine (13) to identify the meaningful concept clusters.

The Varimax factors extracted in this analysis are summarized in Table 1. The five-factor rotation was used for the second grade data and the six-factor rotation for the third grade data. The concepts within a factor are ordered according to their loadings based on the third grade data.

The separate analyses made for grades and concept-series provide two sets of replications. The composition of the factors for the separate sets of concepts, and the loadings of concepts for the two grades, are highly similar for four of the five factors. The first two factors are clearly distinguishable on the basis of combinations of the three factors, Evaluation (E), Potency (P), and Activity (A). Concepts extracted for Factor I can be defined as having *good-strong-active* (E+ P+ A+) connotations. Factor II is comprised of concepts that are *bad-strong-active* (E- P+ A+). While the concepts in Factor III can be characterized, in general, by *good-weak-inactive* (E+ P- A-), they seem, also, to include the connotation of *smallness*. However, it should be noted that, since *strong-weak* and *large-small* both have large coefficients on the Potency dimension, the added distinction may be unimportant; Factor IV, in addition to being descriptive (to the Ss in this study) of things *good-weak-inactive* (E+ P- A-), includes another dimension—the connotation of “wetness.” The fifth factor did not emerge with sufficient

structure in Series A to be easily defined. It is the third most important factor, in terms of the percentage of total variance accounted for, in the Series B list of concepts as rated by the second grade (14.05 per cent), and the second most important factor in the third grade data where it accounts for 14.50 per cent of the total variance. In Series B this cluster is clearly defined by *good-strong-inactive* (E+ P+ A—). Similar connotations are evident in the data for the grade-series 3A, but are absent in the data for the grade-series 2A. In general, the connotations of the extracted concept-factors for the two grades can be adequately described by the three dimensions of Evaluation, Potency, and Activity.

4. Concept Polarization

The polarization indices for each concept were determined by calculating D_{ii} scores using deviations of each of the five factor *means* from 4.00, the origin or center of the scale. A caution in interpreting the polarity of a concept seems warranted in view of comments made by Osgood *et al.* (22). These investigators indicate that calculating polarizations for the means of the judgments made by *N Ss* on each scale "may yield low polarization for either of two reasons: the individual *Ss* may have differed widely in their judgments of a given concept; or they may have consistently agreed in their ratings of a concept, but not have rated that concept extremely on any of the dimensions. [This method] does have the advantage of dealing with group characteristics rather than individual subjects" (22, p. 39). An additional criticism of the present procedure is that mean factor scores obtained by combining two scales may yield low polarization if the ratings of the concept on the two scales differed widely or if the ratings were similar but not extreme. Since the scales used had large coefficients for their respective factors, and the factors are presumably orthogonal, this consideration seems relatively unimportant. The alternative method of determining the polarity of concepts would have been to take the deviation from the origin of each individual's rating of the concept on each scale.

Following calculation of the polarity indices, the concepts were ranked from 1 to 100, according to the magnitude of the index, separately for each of the samples of concepts and for each grade. Each concept's mean and standard deviation of *ranks* across grades was obtained for Studies II and III. The polarity of the concepts, ordered in terms of the standard deviations of the *ranks*, are presented in Tables I, J, and K with polarity indices for each grade. (The concepts rated in Study I, presented in Table I, were not ranked.) In those tables the concepts at the top of the list have highest *shared* polarity

TABLE 1
VARIMAX FACTORS OF CONCEPTS IN SERIES A AND B RATED BY SS
IN GRADES 2 AND 3: STUDY II

Grade-Series			Grade-Series		
Concept	2A	3A	Concept	2B	3B
<i>Factor I</i>					
Courage	89	92	Policeman	91	90
Man	82	89	Marriage	78	87
Father	82	89	Peace	50	84
Author	84	88	Fast	44	83
Freedom	79	88	Progress	59	82
Work	86	86	Pleasure	64	82
Truth	65	86	Music	68	81
Knowledge	79	85	Laughter	65	77
Respect	81	85	Cat	55	76
Friend	62	83	Future	63	76
Success	68	82	Life	76	74
Horse	58	81	Trust	89	73
Power	72	80	Luck	75	70
Per cent TV	33.61	31.32	Per cent TV	21.08	29.44
<i>Factor II</i>					
Danger	91	90	Punishment	85	88
Anger	77	88	Crime	87	87
Guilt	60	88	Battle	87	87
Thief	91	88	Defeat	82	85
Snake	89	87	Fire	80	81
Pain	88	86	Large	13	59
Poison	83	86	Wind	27	55
Thunder	51	65	Strong	21	55
Fear	28	63	Per cent TV	9.59	11.85
Noise	57	61			
Per cent TV	16.99	17.15			
<i>Factor III</i>					
Seed	76	89	Egg	86	79
Color	57	84	Root	48	77
Cup	77	70	Tooth	63	75
Map	19	70	Fruit	78	73
Belief	39	64	Small	55	66
Knot	69	63	Money	72	59
Choice	21	63	Stone	29	58
Per cent TV	8.68	16.19	Food	76	52
			Bread	73	32
			Per cent TV	18.16	12.79
<i>Factor IV</i>					
Water	65	78	River	84	55
Lake	54	78	Slow	22	55
Tongue	78	74	Weak	53	53
Girl	46	66	Cloud	74	47
Woman	27	55	Rain	67	46
Per cent TV	13.00	8.63	Per cent TV	7.80	4.27

TABLE 1 (continued)

Grade-Series			Grade-Series		
Concept	2A	3A	Concept	2B	3B
Factor V					
Tree	34	73	House	93	85
Moon	56	68	Chair	82	81
Sun	01	50	Book	68	76
Noise	-14	-46	Window	85	76
Meat	00	45	Picture	45	76
Rope	03	43	Per cent TV	14.05	14.50
Smoke	70	19			
Color	61	03			
Map	56	02			
Per cent TV	5.28	6.01			

Note: Decimal points in factor loadings are omitted.

and those at the bottom of the list have the greatest variation in polarity among grades. The ranking procedure neglects a consideration of the *degree* of polarity. Thus, concepts with high or low polarity values will be interspersed throughout the array. The reader may identify those with greatest polarity across age groups by the data in the *mean rank* column, with 1 being the most polarized concept and 100 being the least polarized concept.

In a previous study (4), a comparable analysis of all but five of the concepts used in Study II was made of the *H*-indices. The *H*-index conveniently summarizes the frequency and diversity of modifiers associated with each concept in a constrained word-association task. The obtained score was assumed to be an index of meaning, although not necessarily correlated with meaning based on SD ratings. Since parallel procedures were employed in the ranking procedure, the data for the adjective elicitation study and the present study may be compared.

5. The Polarity of Children's and Adults' Ratings

Readily apparent general trends of increasing or decreasing polarity with age, while present, were small. Accordingly, a further analysis of the changes in meaning of specific concepts was made by comparing the mean ratings of concepts in the present study with the ratings made by college Ss in the *Atlas of Semantic Profiles* (11) study. The procedure was simply first to list the mean ratings on the *good-bad*, *strong-weak*, and *fast-slow* scales of the concepts common to the Jenkins *et al.* (11) *Atlas* and the present study. Then the data were inspected, without statistical assistance, to identify concepts that were rated more intensely (increase in polarity), less intensely (decrease

TABLE 2
ILLUSTRATION OF METHOD USED TO INDICATE CHANGES IN POLARITY OVER GRADES

Concepts	Grades				Judged polarity change
	3	5	7	College	
Boulder	220	204	205	150	Increase
Feather	607	600	577	580	None
Glow	400	352	330	407	None
Green	502	450	431	370	Reverse
Kittens	425	429	453	580	Increase
Silk	517	556	500	417	Decrease
Sin	318	366	308	477	Reverse
Wagon	260	195	239	307	Decrease

Note: Decimal points are omitted. Thus 220 is read as 2.20.

in polarity), or that were rated on the opposite end of the scale (reversed directionality) by adults when compared to all of the children's groups. An example of the procedure, based on ratings with the *strong-weak* scales for concepts in Study III, with corresponding judgments, is shown in Table 2.

The example serves to indicate the kinds of judgments made in the analysis. The words *Boulder* and *Kittens* were judged as reflecting an increase in polarity because the college group's ratings were more polarized than those of *any* of the other groups; *Green* and *Sin* were judged as reflecting reversals in direction because the college means for both concepts were on the opposite end of the scale when compared to *any* of the other age groups; *Feather* and *Glow* were judged as reflecting "no change," since the college mean was less polarized than at least one of the other means *and* more polarized than at least one other; and *Silk* and *Wagon* were said to be decreasing in polarity, since the rating by the college group was closer to the neutral point than were the ratings by any of the grade-school groups.

The procedure used for indicating trends is a conservative one and is only an approximation of all the trends that may exist in the data. It permits examination of gross changes in meaning between the groups of children and the adult group. On the other hand, a certain amount of data may be lost, since the procedure fails, for example, to consider those concepts that were rated very similarly by the two younger groups (third and fifth grade) but differed from the ratings made by the two older groups (seventh and college groups). The rating of *Feather* is an example of the latter trend. Furthermore, the use of single scales is not as reliable (5) as factor scores and, thus, may not reflect important trends of lesser magnitude.⁴

⁴ In separate analyses based on five individual scales the standard error of a mean varied according to the scale used, but was strikingly similar among grade levels. With $N = 20$, the standard error was .17 for the *wrong-right*, *first-last*, and *fast-slow* scales; and was .35 for the *strong-weak* and *good-bad* scales.

A summary of the concepts in which age-trends in polarity changes were noted is presented in Table 3. There it may be seen that approximately the same number (about 50 per cent of all concepts) of changes in polarity occur for any one of the dimensions. However, there were 87 increases in polarity, 52 decreases in polarity, and 31 reversals in the direction of ratings on one or more of the dimensions. The greatest number of increases in polarity occur for the Potency ($N = 32$) and Activity ($N = 31$) ratings; the greatest number of decreases in polarity occur for the Evaluation dimension; and the greatest number of reversals occur for the Potency dimension. Out of the 104 concepts used in this analysis, the mean ratings for 39 changed in polarity on one dimension, 33 changed on two dimensions, 22 changed on three dimensions, and 10 did not change on any dimension.

D. DISCUSSION AND CONCLUSIONS

The present study was based on the application of the SD to the judgments of a heterogeneous group of concepts by children. It was not specifically designed for the purpose of studying differences in the localization, polarization, and clustering of concepts rated by different age groups. However, the data suggest the fruitfulness of the approach and provide a potential source of hypotheses for further studies in psycholinguistics and human cognition with children. The gross differences observed in this sampling of concepts indicates the feasibility of the approach for a more intensive application of the SD technique in the study of trends in the development of meaning. The *Atlas of Semantic Profiles for Children* (Tables A through K) provides a basis for comparing the SD with other associative techniques, and for the control of semantic meaning in laboratory experiments in transfer and mediation processes in which children are used as subjects.

1. *Concept Factor Scores*

The mean factor scores, used as the basic data in these studies, indicate considerable consistency across age levels in the localization of specific concepts within the semantic space defined by the dimensions of Evaluation, Potency, Size, Activity, and Warmth. With reference to dimensionality, concepts have similar affective meanings among age levels. The general location (i.e., the direction of the rating with reference to the origin) of a concept in semantic space appears to remain stable over age groups. A concept tends to be judged consistently as *good* or *bad*, as *strong* or *weak*, or as *active* or *inactive* by all age groups studied. A similar conclusion was reached by Donahoe (7) who found, with a much more restricted sampling of concepts, that "evaluative

meaning remained unchanged after nine years, Potency after 12 years, and Activity showed no change over the ages (6, 9, 11, and 22) sampled" (7, p. 28). Thus, the child's conceptualization of his environment appears to be adopted from the adult speech community at a very early age, probably as soon as elementary language facility is learned.

2. Concept Polarity Scores

Within the theoretical framework of the representational mediation process, the polarity index is an indicator of degree of meaning. While the average polarity for concepts (5) increased between grades 2 through 7, the mean changes were small. On the other hand, the data indicate that out of all observed changes over age-groups there were more than twice as many concepts with increased polarity, or reversed direction, than concepts with decreased polarity. Thus, where changes do occur, they are in the direction of more meaning with increases in age. Furthermore, these changes are more likely to occur on the Potency and Activity dimensions than on the Evaluation

TABLE 3
CONCEPTS REFLECTING CHANGE IN POLARITY WITH AGE ON EACH OF THREE FACTORS:
BASED ON A COMPARISON OF CHILDREN'S WITH ADULTS' RATINGS

Polarity changes in evaluation			Polarity changes in potency			
Increase	Decrease	Reverse	Increase	Decrease	Reverse	
Baby	Bible	Wish	Baby*	Square	Barn	Birth
Barn	Boulder	Dirt*	Boulder	Stove	Butter	Blue
Bath	Candy	Fear*	Cold	Street	City	Bread
Butter	Church	Slow*	Color	Success	Courage	Child*
Child	City		Comfort	Taste	Fear*	Dark
Cushion	Danger*		Effort	Tree	Gojey	Garment
Effort	Dream		Fire	Trunk	Man	Girl*
Garment	Fire*		Hammer	Truth	Silk	Green
Glow	Foot		Health		Trouble	Hate*
Hammer	Green		House		Wagon	Light
Hate*	Hand		Joy			Puppies*
House	Health		Justice			Rage*
Justice	Joy		Kittens*			Sickness*
Kitchen	Kittens		Mallet			Sin*
Lamp	Red		Memory			Small*
Leadership	Religion		Mountain			Stem
Memory	Silk		Music			Thief*
Music	Spider*		Nurse			Web
Peace	Street		Ocean			White
Root	Table		Progress			
Sin*	Taste		Red			
Stem	Trouble*		River			
Stove	Trunk		Root			
Trees	Wagon		Spider			

TABLE 3 (continued)

Increase	Polarity changes in activity		No change in polarity	
	Increase	Decrease	Reverse	
Anger	Light	Baby*	Boulder*	Boy
Bath*	Moon*	Bed*	Food	Chair
Child	Progress	Butter*	Lake*	Fast
City	Rage	Cold	Peace*	Father
Comfort*	Religion	Foot	Red	Feather
Courage	Root*	Green	Stars*	Foreigner
Danger	Sickness*	Justice	Street	Mosquito
Doctor	Sin	Kittens	Wagon	Star
Dream	Sleep*	Money	Trunk	Window
Effort	Snail*	Ocean		Woman
Fire	Spider	Puppies		
Hammer	Taste	Silk*		
Hand	Trees	Song		
Health	Water	Square		
Joy		Success*		
Kitchen		Table		
Leadership		Wish		

Note: Ratings by adults were taken from Jenkins, Russell, and Suci (11). Changes in Polarity are read as follows: *Increase*—polarity of ratings is greater for adults, *decrease*—polarity is greater for children, *reverse*—polarity changes from positive to negative or negative to positive on the dimensions involved.

Evaluation comparisons are based on mean ratings on the *good-bad* scale; Potency comparisons on the *strong-weak* scale; Activity comparisons are based on mean ratings on the *fast-slow* scale. Asterisked (*) concepts are those with dominant negative polarity, for adults, on the right hand term (*bad, weak, or slow*) of the scales representing the respective factors. All other concepts have dominant positive mean ratings on the left hand term (*good, strong, or fast*) of the scales representing the respective factors.

dimension. Nevertheless, the overall results imply that a general increase need not be expected in the meaning of all concepts. Some concepts, because of the simplicity of the experiences required for the development of meaning, or because of the intensity of early experience, mature early; such concepts appear to become saturated with connotative meaning by the time the child is in the second grade. Whatever experiences are encountered following that period are sufficiently consistent so as to have little effect on the later location of the concept in semantic space. Other concepts become more meaningless (decrease in polarity or are rated less intensely) with age. This finding may be less acceptable than the others. However, decreases in meaning may occur for at least two reasons: First, relative to the child's frame of reference, objects may be perceived more intensely by the child than by the adult. Second, a decrease may occur as a result of satiation (16) where it is assumed that meanings become more diffuse through continual experience with the word

in a variety of contexts. Other processes contributing to a decrease in polarity include the differences in children's and adult's accumulated reinforced (or nonreinforced) experiences with specific linguistic symbols.

The assumption that meaning increases with age was found to be restricted to certain classes of concepts. (Although context may be an important variable, Heise (8) found that the use of defining sentences had no significant effect on the SD ratings of concepts.) An inspection of the comparisons of children's with adults' ratings indicates that 24 of the concepts are (e.g., *Comfort*, *Effort*, *Courage*, and *Danger*) characteristic of evocative speech in which the principal consideration is attitudinal arousal (20). The remainder (e.g., *House*, *Dog*, *Sun*, and *Lake*) can be classified as concrete terms in which the essential characteristic is the correctness of the symbolization and the truth of the references. Out of all possible changes on the comparisons of children's with adults' ratings, 40 per cent of the abstract concepts increase and 7 per cent decrease in polarity. Of the concrete concepts 28 per cent increase and 23 per cent decrease in polarity. Thus, it is apparent that increases in polarity, with age, are more likely to occur for the more evocative concepts than for the concrete concepts. The implication is that denotation may be learned earlier than connotation.

3. *Concept Clusters*

The factor analysis of concepts yields clusters that are clearly defined by the dominance of specific combinations of the three salient dimensions of meaning. While the denotative characteristics of concepts within a cluster are extremely diverse, there is clearly implied a set of common mediators for each cluster. An impressive aspect of this analysis is the fact that clusters based on two independent sets of concepts were identifiable by the same combinations of dimensions, and that the coefficients for the concepts across the two grades were similar for the three most salient clusters.

4. *Semantic Differentiation, Word-Associates, and Meaningfulness*

The norms have been applied in two investigations: In the first, following Pollio (25), a word was considered as evoking two classes of semantic responses: word associates and meaning. Word-association norms are instances of the first class of responses where preferred associates to a given word are determined. The second class of responses can be measured by the SD. The association of a stimulus word with a preferred response is assumed to be determined by the similarity in meaning of the two words. Opposite associates are excluded, since contrast responses are assumed to be a result of cultural verbal conditioning in which meaningful support is unnecessary (21). The

two words come to have communality of meaning, since they have been used to designate similar events and have been used in similar contextual arrangements. Within the representational mediation response paradigm (23) both the stimulus word and its primary associate should, accordingly, have similar locations in semantic space. Pollio found support for this hypothesis using the Woodrow and Lowell (29) norms for word associates of children and the SD ratings of adult Ss as given in the *Atlas of Semantic Profiles* (11). However, since the word-association norms were obtained several decades ago and since children's word associations were compared with adult ratings of concepts on the SD, it seemed desirable to replicate the study using more recent word-association data and SD ratings from comparable groups of children. The replication was accomplished by using the Palermo and Jenkins (24) norms and the SD data from the present study. All data were based on responses of children in the fifth grade. There were 31 pairs of stimulus-words and primary associates in the word-association norms for which SD ratings were also available. The correlations of each of the salient factor scores for these pairs of words were computed. The resulting coefficients were .64 for the Evaluation factor, .47 for the Potency factor, and .62 for the Activity factor. The results compare favorably with those obtained by Pollio. When the pairs of words involving opposite responses were eliminated, the correlations for all factors were increased further. (Semantic differential ratings of the stimulus word and its opposite were inversely correlated.) These data imply that the primary associate is mediated by similarity in connotative meaning.

The second study employed a comparison of polarity scores with meaningfulness (m). The polarization of a word has been shown by Jenkins and Russell (10) and Noble (19) to be correlated with a measure of the number of associates (m , or meaningfulness) elicited to a word-stimulus. Staats and Staats (27) explain that this relationship holds because the same operation involved in language learning produces both meaning and word associations.

In the present data there were 14 words common to the Noble (18) list. Rank order correlations between polarity indices and the m value as given by Noble were computed for these words. The obtained rho's were .80 for the third grade, .85 for the fifth grade, and .73 for the seventh grade data. These correlations compare favorably with those found in the aforementioned studies, despite the fact that all but one of the words were in the upper-half of the distribution of m -values.

The above discussion does not imply an identity between word-associates and semantic meaning or of an identity between polarization and m . The

words used in the correlations were, for the most part, neutral words. In an analysis of the effect of the emotionality (connotative meaning) of words on the relationship between polarization and m made by Koen (15), a significant correlation between m and polarization was obtained for neutral but not for emotional words. The polarization index was very sensitive to the emotionality of words, whereas m was not. An important outcome of Koen's study was the finding that frequency of usage is a significant variable in predicting m in all circumstances, but has little effect on the relation between m and polarization. Thus, the affective quality of words, while correlated with word-associations under certain conditions, is independent of meaning as measured by traditional word-association techniques suggesting the possibility that the emotionality of words may be learned by a process different from that by which the word-associate is learned.

The discussion of the analyses described above compares the present normative SD ratings with two conceptually different classes of "meaning." Integrated with the conclusions from the studies of Koen (15) and of Staats *et al.* (28), the results imply that the emotionality or meaning of words, as measured by the SD, might profitably be given separate consideration from those data obtained by more traditional word-association techniques. It appears that semantic meaning may be sufficiently important to warrant the use of specific controls in laboratory investigation of verbal processes.

5. *Symbolic Conceptualizations of Self and Parents*

Another application of these norms was made by comparing the child's conceptualization of himself and his parents, as described in the Results Section. The data support some of the classical notions regarding manifestations of the sex role. Language learning that accounts for the communality in semantic conceptualization of the sex roles apparently develops prior to entrance to school (12). As with adults (11, 23), *Father* is rated as more Potent and Active than is *Mother*. Although the children conceptualized themselves (Me) as being more similar to the like-sex parent, the similarities and differences (differences between distances) are not as clearly defined in the ratings of *Father* as in the ratings of *Mother*. It is suggested that the more frequent contact with females (e.g., mothers and women teachers) than with male models (e.g., fathers and men teachers) favors the location of Me , by both sexes, with *Mother* in semantic space. Another interesting finding is that the distance between the ratings of Me and both parents for the sixth grade girls' ratings is greater than that for the sixth grade boys' ratings, possibly reflecting the earlier maturation of independence in girls. Children (both sexes) in the

second grade locate *Teacher* and *Friend* in similar positions in the semantic space. However, after this period these distances become increasingly greater for boys but remain the same for girls. In general, these data indicate the potential use of the SD in studying further such events as sex differences in role identification and the self-concept.

E. SUMMARY

In the exploratory descriptive study of children's use of the semantic differential, a series of 220 concepts was rated by children in grades 2 through 7. Summaries were presented of the location of the concepts in semantic space defined by the factors Evaluation, Potency, Activity, Size, and Warmth; and of the distance of the concept ratings (polarity) from the origin of the semantic space. Factor analyses of two groups of *concepts* rated by children in grades 2 and 3 indicated that the extracted clusters were, in the main, consistently defined by the several combinations of the bipolar directionality of the three salient factors, Evaluation, Potency, and Activity. Age trends in changes in meaning appeared to be most dominant for concepts with emotional overtones. Children's ratings of neutral words tend to be similar to adult ratings implying that the meanings for these words, as indexed by the semantic differential, are developed early, probably when the child first learns to use language. Semantic meanings of stimulus-words and primary associates, elicited in a free-association task, were significantly correlated, as were the polarity index and a measure of meaningfulness (*m*). These results were discussed in terms of previous evidence regarding the independence of semantic meaning from meaning measured by other word-association techniques. Differences in conceptualization of the sex-role by girls and boys were illustrated to suggest additional potential applications of the semantic differential technique in studying the verbal behavior of children.

Only a beginning has been made in this summary to explore the potential uses of the SD. Other uses are suggested by Heise (8). The test-retest reliability of the SD with the groups of children studied here has been examined (5) and found to be an acceptably stable instrument, particularly when factor scores are used. Since the child's use of this instrument is similar to that of adults, comparisons of measures of semantic meaning over a wide age range are possible. Intensive studies directed toward specific hypotheses are still required to delineate clearly the characteristics of concepts that change in connotative meaning over the developmental span. Other data to parallel those currently available for word-association norms must still be accumulated for comparisons with more traditional techniques comparable to analyses made

by Pollio (25). While previous laboratory investigations (6) have provided positive evidence for semantic mediation in children's learning, the present data should enable more specific control of connotative meaning congruent with theoretical considerations. That the SD appears to tap, in a significant way, the emotionality of words suggests further avenues of exploration in the formation and change of children's attitudes and values in laboratory investigations and in educational settings.

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EFFECTS OF DEPRIVATION PROCEDURES ON
CONSUMMATORY MOTIVATION IN
THE DOMESTIC CHICKEN*¹

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A. PROBLEM

Although Grindley (2) and Wolfe and Kaplon (3) have studied the relationship between the amount of reward, consummatory activity, and learning in the domestic chicken, information concerning consummatory preference under various conditions of deprivation is lacking. Accordingly, the purpose of this study was to provide data on consummatory preference in the chicken, using age and type and level of deprivation as the critical independent variables. This study follows, in general, the approach used by Candland and Culbertson (1) in studying the consummatory preference in the albino rat.

The independent variables were type of deprivation (food, water, or both), age (7 or 65 days) and the extent of deprivation (80 or 90 per cent body weight). The critical dependent variable was the preference of the *S* for either food or water. In addition, the latency of the *S* in leaving the starting box, the running time of the *S* from the start box to the goal box of his initial choice, and the percentage of *S*s choosing food or water were recorded on the assumption that the preference of the *S* for either food or water reflects the motivational preference of the *S*, while the latency and running times represent measures of the strength of the motivational state.

B. METHOD

1. *Subjects*

The *S*s were 70 male white leghorn chickens of ages 7 days ($N = 35$) and 65 days ($N = 35$) at the beginning of testing. All *S*s were hatched at a local hatchery and raised in the departmental colony at 24 hours of age in communal

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¹ This research was supported by Grant MH 06998-02 from the National Institutes of Health to Douglas K. Candland (Bucknell University, Lewisburg, Pennsylvania), from whom reprints may be obtained.

² Robert J. Lakatos and Robert S. Moyer were undergraduate research participants, National Institutes of Health, 1964.

cages equipped with food and water trays and light bulbs. The *Ss* were fed Purina Startina and maintained at 82°F. Relative humidity varied between 50-60 per cent.

2. Apparatus

The apparatus was a T-maze equipped with photocells connected to timers. The stem of the T consisted of section A (1½ feet long) and section B (2½ feet long). The cross of the T consisted of a two-foot section (C) at the top of the stem, and two one-foot-long sections (D) at the tips of the cross. The maze was 15 inches in height and one foot in width. The photocells were placed at the beginning of sections B, C, and D, and wired to programming and recording apparatus. Thus, there were one-half-inch beams of light at the base of the maze and at the beginning of each section. Food (Purina diet) was placed on the right side and water on the left side of the T in small dishes for half the *Ss*; the remaining half were presented with the opposite arrangement.

3. Procedure

The chickens in each age group were divided into four groups: food deprived, water deprived, food and water deprived, and control. All groups except the control group were subdivided into groups deprived to 80 or 90 per cent of their predeprivation weights, yielding five *Ss* in each group. When the *Ss* had reached criterion weights (80 or 90 per cent deprivation), they were tested once a day in the maze for 10 consecutive days. If no response occurred within a 90-second period, the *S* was led to a randomly selected goal compartment (food or water) for one minute, then placed in the start box, and then led to the other goal box for one minute by gentle prodding. If the *S* failed to respond after the first trial the procedure was alternated, so the *S* was never led to the same goal first on two consecutive days. When the *S* responded to either food or water, this training was discontinued. The amount of time each *S* spent in each section of the maze and the initial choice (either food or water) made by each *S* was recorded.

C. RESULTS³

Figure 1 shows the percentage of *Ss* choosing food or water as a function of age, type and level of deprivation, and trials. In all figures, ages are represented by 7 and 65 (7 days old or 65 days old) and levels of deprivation are represented by 80 and 90 (80 per cent and 90 per cent of predeprivation weights). Figure 1 (top) shows that animals deprived of food select food

³ Sidney Alpern Manning conducted the statistical tests.

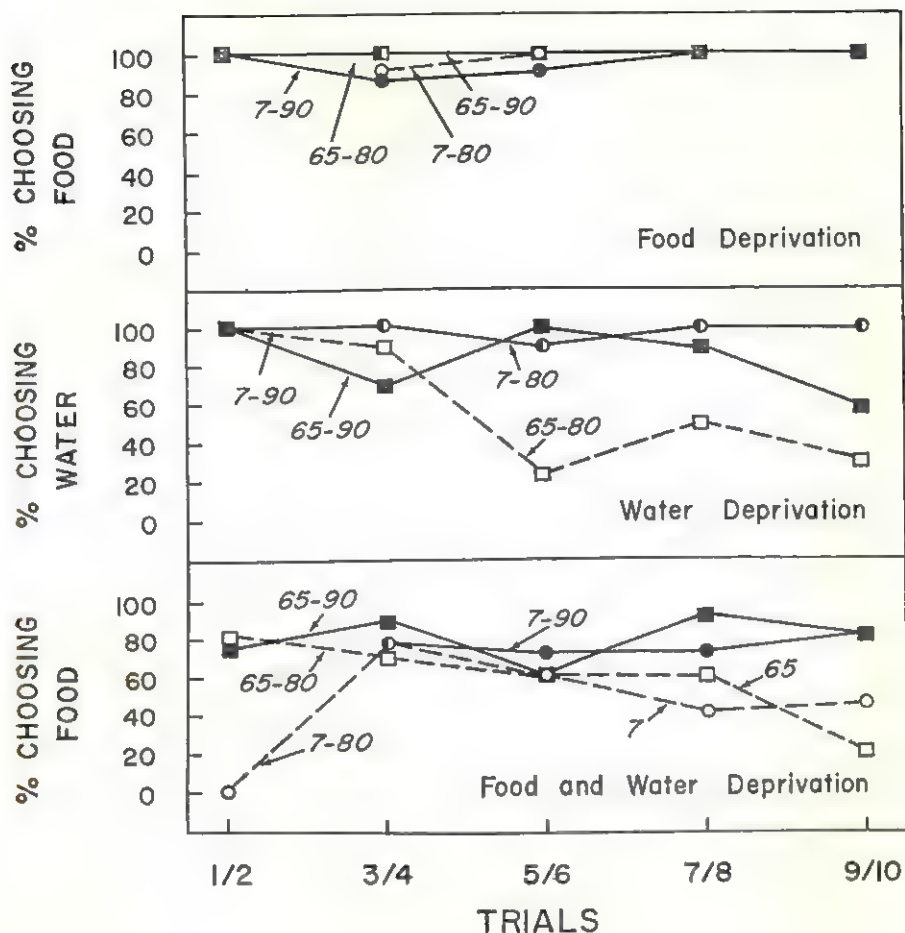


FIGURE 1
PERCENTAGE OF ANIMALS CHOOSING FOOD OR WATER AS A
FUNCTION OF TRIALS AND EXTENT OF DEPRIVATION

No plot is made for the food-deprived 7-80 group, since no choices occurred on the first two trials. Groups are represented by two numbers: the first number (7 or 65) refers to age and the second number (80 or 90 per cent) refers to extent of deprivation.

between 90-100 per cent of the choices. It is apparent that neither age nor extent of deprivation affect the clear preference of food-deprived chickens for food.

The data on preferences under water deprivation (Figure 1 middle), however, indicate an age difference. The younger chickens (7 days) perform under water deprivation almost exactly as they did under food deprivation

(i.e., they prefer the substance of which they have been deprived 90-100 per cent of the time). The older birds, however, change from a 90-100 per cent preference for water in the early trials to no preference (50-50 per cent in the 90 per cent deprived group and only 20 per cent preference in the 80 per cent deprived group during the latter trials.

The data on food and water deprivation are less consistent and there appear to be no differences in preference as a function of age. There exists, however, a slight difference as a function of inanition condition. The 90 per cent deprived *Ss* show a 70-90 per cent preference for food throughout the trials. In contrast (primarily in the latter trials), the 80 per cent deprived groups prefer water to food—most markedly in the older group. Figures 2, 3, and 4, respectively, represent the percentage of *Ss* responding, latency of the response, and running time for *Ss* in each deprivation condition. In all cases, performance with respect to these variables becomes asymptotic by the fourth trial.

In the statistical analyses of the data, results on Trials 1 to 4 were omitted so that the initial training trials would not obscure the effects of treatment variables. It is clear that in all cases (except control) there was a significant change from Trial 1 to Trial 10. (Hence for each response variable, the effects studied were (a) age—7 *vs.* 65; (b) level of deprivation—80 *vs.* 90 per cent; (c) trial—5 and 6, 7 and 8, and 9 and 10; and (d) type of deprivation—food, water, or food and water.) In addition, all first order interactions were combined into an estimate of random variability. The response variables studied were running time and latency.

An analysis of variance for running time yielded the following significant factors: (a) age, $F = 7.402$, $df = 1, 48$, $p = < .01$; (b) age and type of deprivation interaction, $F = 3.384$, $df = 2, 48$, $p = < .05$; and (c) interaction of all factors, $F = 3.01$, $df = 4/48$, $p = < .05$. The analysis for latency yielded the following significant factors: (a) trials, $F = 7.278$, $df = 2, 48$, $p = < .01$; (b) type of deprivation interaction, $F = 4.42$, $df = 2/48$, $p = < .05$; and (c) age, weight loss, and type of deprivation interaction, $F = 2.53$, $df = 4, 48$, $p = < .05$.

From Figure 1, it is clear that food deprivation provides the most invariant responding. Regardless of age or amount of deprivation, the domestic chicken selects food, when under food deprivation, almost 100 per cent of the time. In the rat, using hours of food deprivation rather than weight loss, the percentage choosing food rises slowly to an asymptote of around 90 per cent following 23 hours of food deprivation. It should be noted, however, that

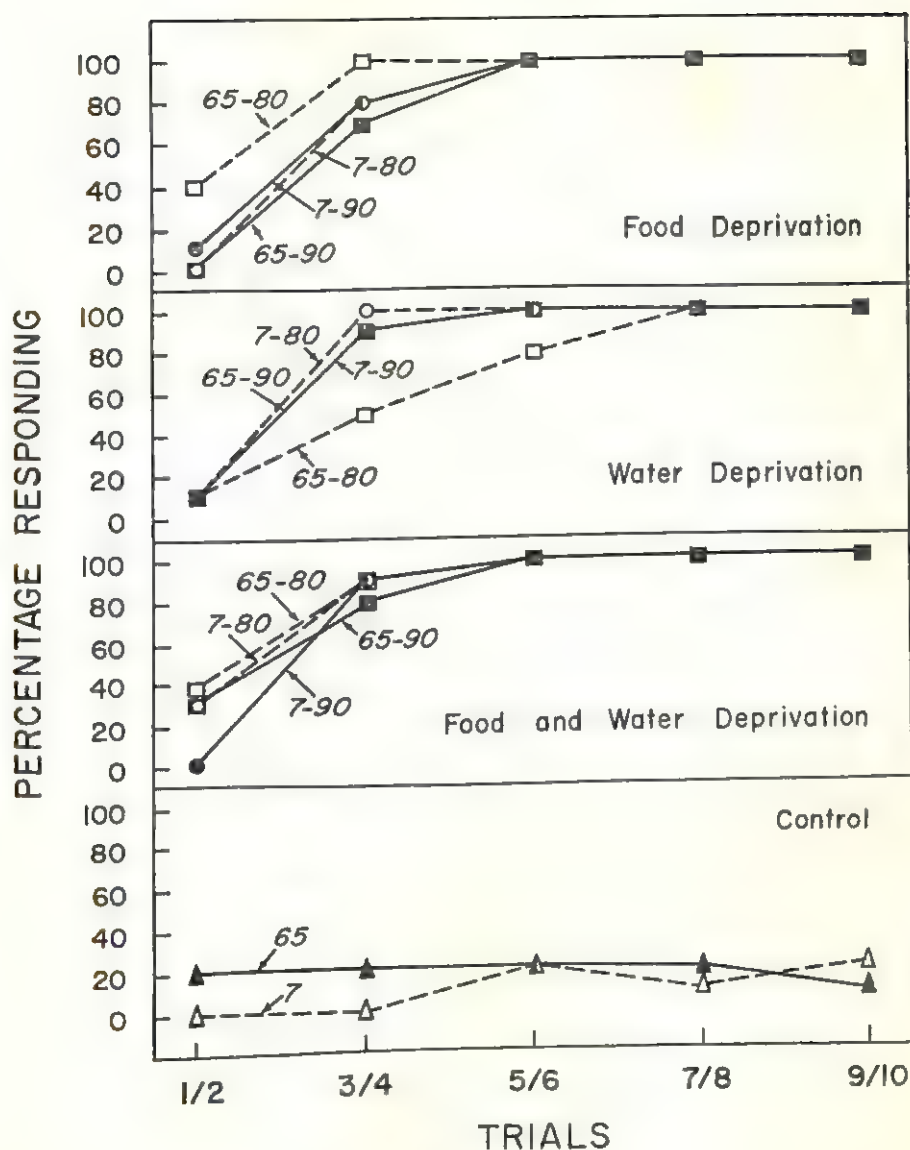


FIGURE 2
PERCENTAGE OF ANIMALS RESPONDING AS A FUNCTION OF TRIALS
AND DEPRIVATION CONDITION

Groups are represented by two numbers: the first number (7 or 65) refers to age and the second number (80 or 90 per cent) refers to extent of deprivation.

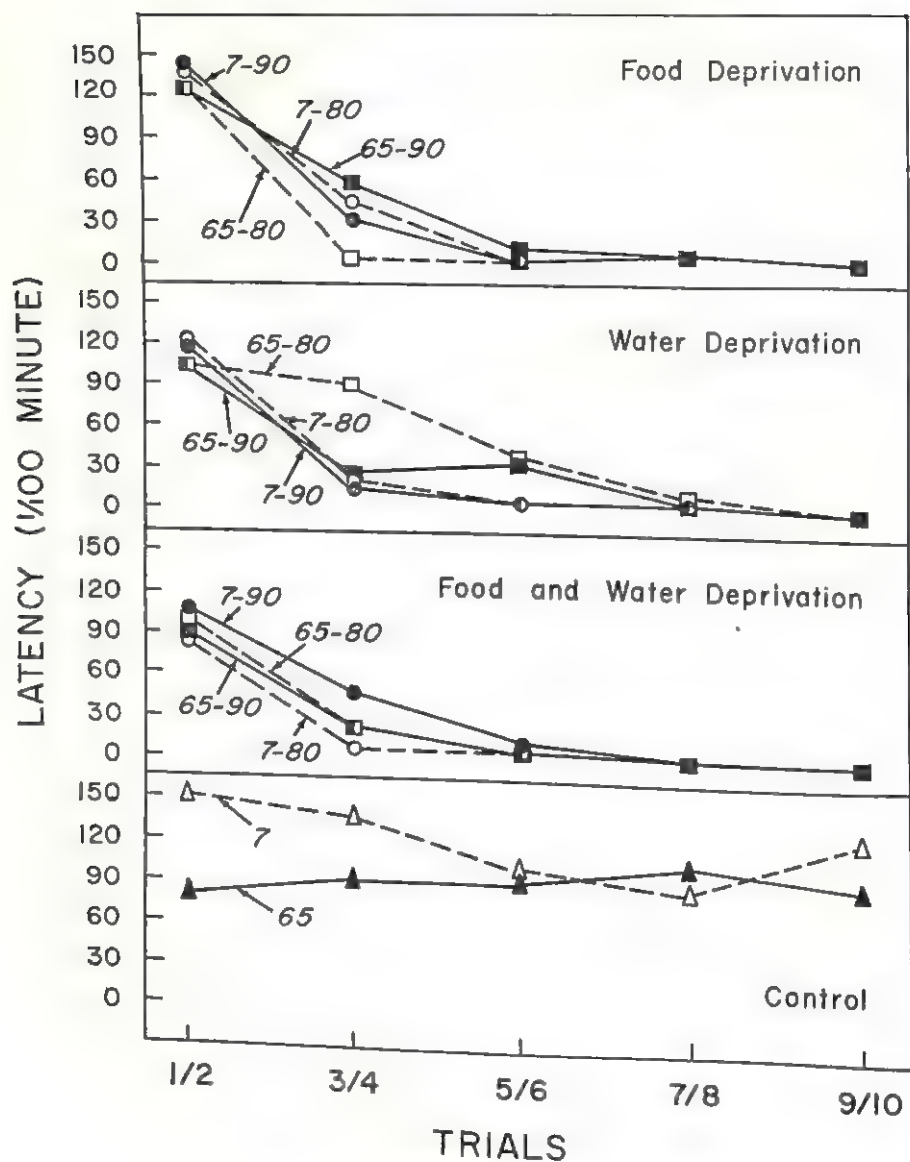


FIGURE 3

LATENCY AS A FUNCTION OF TRIALS AND DEPRIVATION CONDITION

Groups are represented by two numbers: the first number (7 or 65) refers to age and the second number (80 or 90 per cent) refers to extent of deprivation.

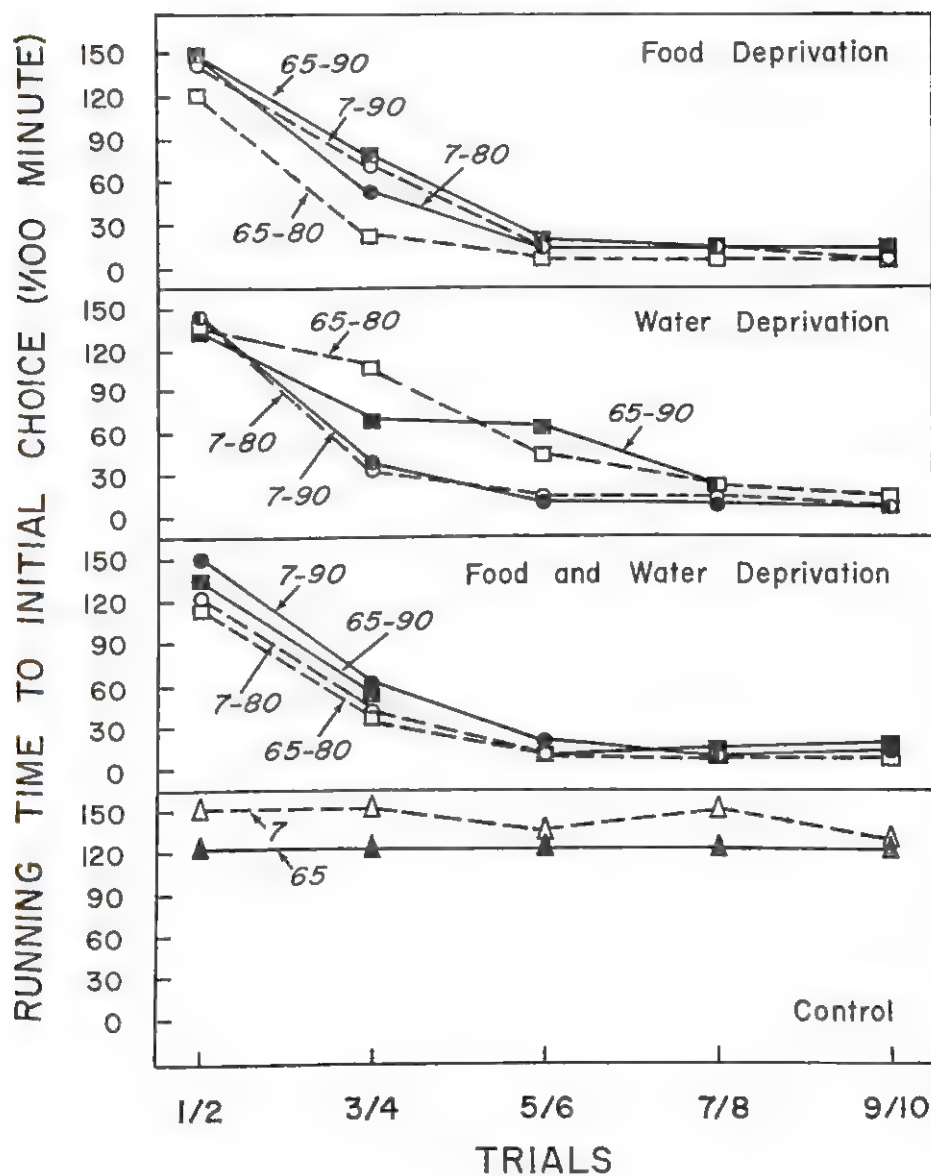


FIGURE 4

RUNNING TIME FROM END OF START BOX TO CHOICE POINT AS
A FUNCTION OF TRIALS AND DEPRIVATION CONDITION

Groups are represented by two numbers: the first number (7 or 65) refers to age and the second number (80 or 90 per cent) refers to extent of deprivation.

percentage weight loss (as in the chicken) and hours of deprivation (as in the rat) are relatively comparable, since rats lost between 8-12 per cent of body weight during the first 24 hours as a function of age and type of deprivation; and thus the rat group (1) is comparable to the 90 per cent chicken group.

Water deprivation leads to greater variability in responding in the chicken than does food deprivation, particularly among older animals deprived to 80 per cent. These *Ss* show a preference for food, even though water deprived, as trials progress. Since Purina chicken feed normally contains around 3 per cent water, it is probable that this difference between food-deprived and water-deprived chickens in choice of substance reflects the well-known interaction of food and water deprivation in rodents. This interpretation is reflected in the percentage choosing food under conditions of both food and water deprivation, where the percentage selecting runs, in general, between 60-80 per cent but does not reach the clear asymptotic level shown by *Ss* that are food deprived only.

Measures of both the percentage of *Ss* responding and of the latency of response reach asymptote around the fourth trial regardless of deprivation condition. Age is a significant variable in running time, while the number of trials is a significant variable in latency.

These data suggest the importance of the dependent variable that is selected in studies using the domestic chicken, for although one measure, such as choice of food or water, may show differences as a function of deprivation state, other measures, such as latency, may fail to show such differences.

D. SUMMARY

Seventy white leghorn chickens were divided into four groups: food deprived, water deprived, food and water deprived, and control. Each group was further divided into two age groups (7 and 65 days), each of which was deprived (except for controls) to either 80 or 90 per cent of their body weights. They were placed in a T-maze, one arm of which held water while the other held food, for 10 consecutive daily trials. Latency, running time, and consummatory preference were automatically recorded. Food deprivation provides the most invariant responding, although differences in preference as a function of age and percentage of deprivation appear under water deprivation. Percentage of *Ss* responding and latency of response reach asymptote around the fourth trial irrespective of age or inanition condition. Comparisons to a similar study on the albino rat are made.

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MAZE EXPLORATION IN YOUNG RATS OF FOUR AGES*

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A. INTRODUCTION

Age-related changes in locomotor exploration of rats have been investigated in several recent studies. Broadhurst (1) reported that open-field locomotion increased significantly from 53- to 113-day-old rats, but not from 111- to 238-day-old Ss. Although obtaining no significant main effects of age on open-field exploration between 60- and 100-day-old rats, Foster (2) found age to be an important variable in that it interacted significantly with situational complexity, sex, and hours of deprivation to influence exploration. Furchtgott, Wechkin, and Dees (3) observed a significant decrease in open-field locomotion from 30- to 163-day-old rats, but not from 163- to 373-day-old Ss.

For the ages employed, these studies report similar findings for the older rats but not for the younger groups. Further, the limited sampling of the younger ages in these studies does not permit an evaluation of the possibility of an age of peak exploration in the rat, as Welker (7) has suggested. The present study was designed to observe exploratory behavior in more groups of young rats than have been employed in previous research.

B. METHOD

1. Subjects

The Ss were 60 albino rats, 20 males and 40 females, of four age groups. In each age group, one-third of the animals were males. On the first day of testing the range of ages in days in the groups was 24-30 for 12 rats, 50-53 for 15 rats, 75-81 for 18 rats, and 112-119 for 15 rats. The mean ages for these groups were 27, 51, 78, and 116 days. All animals came from a colony of rats maintained in the Psychological Laboratory of the University of Miami. Each age group had animals from two litters. The litters used were those whose birth dates permitted the closest approximation of the ages desired at the time of testing. This essentially random method of forming the age groups permitted the testing of all animals during the same period, thus tending to control for extraneous environmental variables.

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2. *Apparatus*

An enclosed, symmetrical Y-maze was used. Each arm consisted of two units of equal length; two arms were 24 inches long, while the third arm was 20 inches long. Each arm was $5\frac{1}{2}$ inches high and $4\frac{3}{8}$ inches wide (inside dimensions), with a hardware cloth top. Both units of one arm were white; a second arm had a white inner unit and an outer unit that was white with two black stripes 2 inches wide extending across the floor and up the walls; both units of the third arm (object arm) were white. A total of 13 small black objects—such as a toy mouse, a beaded chain, a typewriter ribbon can—were fastened along the floor and sides of the outer 12 inches of the object arm. This arm was shortened to compensate for the surface area of the objects in the arm so that the surface area available for exploration was the same in each arm. The amount of black area in the black arm was equal to the surface area of the black objects in the third arm. The choice point was white and had a hinged top of transparent Plexiglas. The maze was placed on a table in the center of a 6-foot square enclosure formed by black curtains. The table legs rested on 1-inch thick pieces of foam rubber. A 50-watt bulb located 57 inches above the floor of the choice point provided the only illumination in the room. A metronome set at 184 beats per minute was used as a masking sound.

3. *Procedure*

The animals were tested in squads of four, one from each age group. The sequence of testing within squads was systematically varied from squad to squad in order to approximately equalize factors, such as temperature, humidity, and time of night. All of the data were collected in eight nights (during Easter vacation) when the building and campus were quiet and deserted. Extramaze stimulation was further controlled by interchanging the arms after each squad of four rats in a systematic fashion. The animals were observed through a small hole in one side of the curtains.

Each animal was tested at the same time on four consecutive days. After 3 minutes in the experimental room, the animal was taken from its individual home cage and placed in the maze at the choice point. The path taken during each minute of the 10 minutes in the maze was traced on maps of the maze. The time spent in each arm of the maze and in the choice point was also recorded. An animal was judged as having entered a unit when all four feet had crossed into the unit. Food and water were always present in the home cage but never in the maze.

C. RESULTS

The results were analyzed as appropriate by the critical ratio for proportions and by the following techniques as described by Siegel (4): Kruskal-Wallis one-way analysis of variance, Mann-Whitney *U* Test, and Wilcoxon matched-pairs signed-ranks test.

1. Number of Units Entered

The mean number of units entered by each age group on day 1, on days 2, 3, and 4 combined, and for all four days combined are shown in Figure 1.

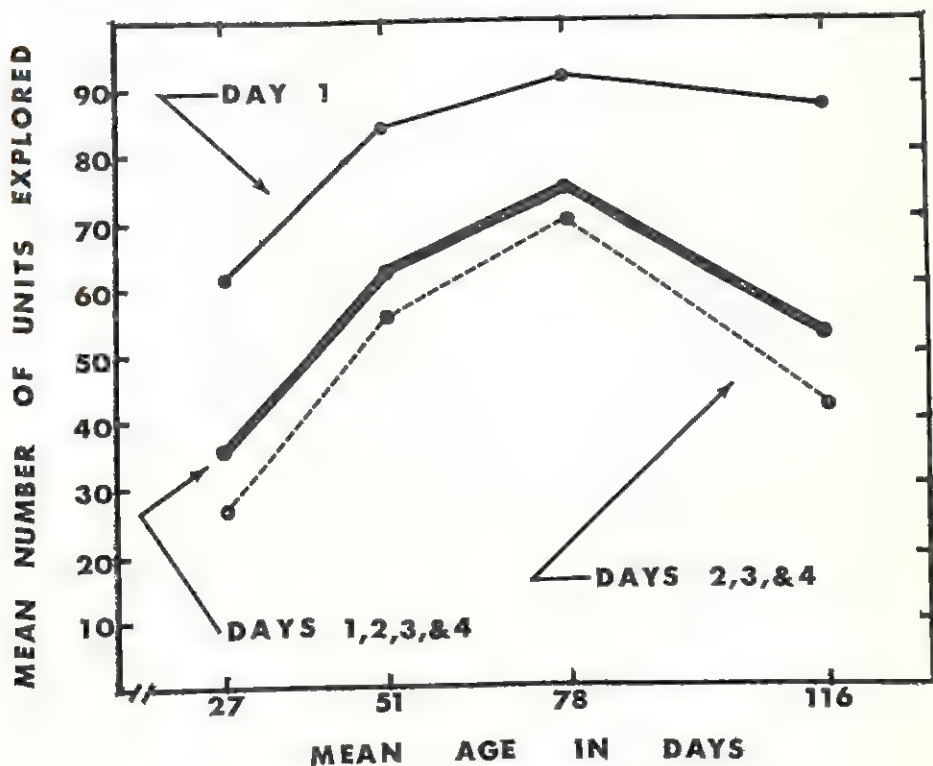


FIGURE 1
AMOUNT OF LOCOMOTOR EXPLORATION AS A FUNCTION OF AGE

Each age group explored significantly more on day 1 than on days 2, 3, or 4. There were no significant differences between days 2 and 3, 2 and 4, and 3 and 4.

Significant differences existed among the four age groups on each day.

Analysis of the data showed (a) that group 27 explored significantly less than groups 51 and 78 on day 1, days 2, 3, and 4 combined, and all four days combined; (b) that group 27 explored significantly less than group 116 on day 1 and on all four days combined; (c) that group 78 explored significantly more than group 116 on days 2, 3, and 4 combined and on all four days combined but not on day 1; and (d) that the other comparisons did not differ significantly.

2. Other Analyses

a. *Exploration of each arm of the maze.* The percentage of units of each arm entered for each group for all four days combined based on the total number of units entered per group was obtained. For each of the age groups, the four-day percentage exploration of the object arm was very similar and was significantly larger than that of either of the other two arms. The average percentage exploration for all groups combined was 40.7 for the object arm, 31.3 for the black and white arm, and 28.0 for the white arm.

b. *Time spent in arm containing objects.* On day 1, group 27 spent significantly more time in the object arm than did any of the other three groups. However, the time spent in the object arm by group 27 on subsequent days was such that its mean time for all four days combined, 1232.4 seconds, did not differ significantly from the mean times of the other three age groups, 1216.5, 1214.4, and 1272.7 seconds respectively. Typically, rats of all age groups spent most of their time in the object arm actively exploring (oriented toward and sniffing at) the various objects, one at a time. The fact that approximately 40 per cent of the units entered by all groups were object-arm units and that all groups spent approximately 50 per cent of their time in the object arm indicates considerable agreement between the locomotion and time measures of exploratory behavior in this study.

c. *Relation between amount of exploration and time in maze.* The number of units entered per two-minute period was plotted for each age group for each day, for all four days combined, and for days 2, 3, and 4 combined. Inspection of these 24 curves indicated that the curves for the various groups were similar and that, except for a slight flatness on day 1, all of the curves showed the marked negatively accelerated decline characteristic of locomotor exploration of rats in this type of maze.

d. *Orderliness of entry into different arms.* The percentage of entry of three different arms in succession based upon the possible number of such triads was obtained for all four groups. That the groups were similar in this measure of the tendency to explore the maze systematically is indicated by

the percentages for all four days combined, which were 58.5, 55.7, 56.5, and 61.5, in order from the youngest to the oldest group.

D. DISCUSSION

The results suggest that a period of maximum locomotor exploration in the albino rat is located somewhere between 51 and 116 days of age. This finding is consistent with Welker's (7) view that there is an age of maximum exploration for each animal type.

The finding that the youngest age group spent more time on the first day actively exploring the objects in the object arm than did any of the three older groups differs markedly from Welker's observation (6) that young chimpanzees (1- to 2-year-olds) showed initial timidity to novel objects as compared to older chimpanzees (3- to 4-year-olds). These contrasting observations raise the possibility of species differences in the development of exploratory behavior in young animals.

A further finding is that the age groups were similar in dimensions of exploratory behavior other than amount of locomotion: all groups explored the object arm more than either empty arm, explored the maze in relation to time of exposure in a similar fashion, tended to explore the various arms of the maze in a similarly systematic fashion, and explored more on the first day than on later days.

The fact that the 51-day-old group explored approximately the same amount as the 116-day-old group is similar to Foster's (2) finding of no significant overall difference in exploratory behavior between 60- and 100-day-old rats. Since previous research has shown differences in locomotor exploration between stock and inbred rats (8) and among different inbred strains of rats (9), the difference between the present results and Broadhurst's (1) report of increased locomotor exploration between 53- and 113-day-old rats is perhaps attributable to the fact that Broadhurst's *Ss* came from an emotionally reactive strain of rats.

Since the amount of time that the 27-day-old group spent actively exploring the objects in the object arm of the maze was approximately the same as that of the other groups, their lower amount of locomotor exploration would not seem to be due to greater fearfulness or timidity.

The deviations in locomotor exploration from the 78-day-old group in the present experiment would appear to be due (*a*) to slower satiation in the younger rats and (*b*) to more permanent satiation after the initial arousal of the exploratory tendency in the older rats. The assumption that an aroused

exploratory tendency satiates more slowly (persists longer) in younger rats implies that the younger rat would spend more time exploring each successive stimulus aspect of the maze, thereby covering less distance in a given time period. The development of larger amounts of permanent satiation after initial arousal in rats older than the optimum age for exploration implies lower arousal and less locomotor exploration. The location of the peak amount of locomotor exploration would be immediately before the age at which larger amounts of permanent satiation begin to appear.

Evidence consistent with part *a* of the above hypothesis has been reported for the chimpanzee (5) and the albino rat (3). The fact that the 78- and 116-day-old rats in the present experiment differed significantly in the amount of locomotor exploration on days 2, 3, and 4 but not on day 1 is consonant with part *b* of the above hypothesis.

It should be noted that it follows from the hypothesis that measures of exploration based on locomotion do not accurately reflect the strength of the exploratory tendency ("curiosity") in rats younger than the age of maximum locomotor exploration.

E. SUMMARY

The amount of locomotor exploration and time spent in each arm of a Y-maze, one arm of which contained various small objects, was obtained for 10-minute periods on four consecutive days for groups of albino rats whose mean age was 27, 51, 78, and 116 days. The amount of locomotor exploration was found to increase with age to a maximum and then decrease. The youngest group spent more time exploring the objects on the first day than did the other groups. The groups were similar in other dimensions of exploratory behavior. It was hypothesized that the differences in locomotor exploration were a function of slower satiation in younger rats and more permanent satiation in rats older than the age of maximum locomotor exploration.

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AGE DIFFERENCES IN AVOIDANCE CONDITIONING AS A FUNCTION OF DISTRIBUTION OF TRIALS AND TASK DIFFICULTY*¹

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A. PROBLEM

Many studies concerned with relationships between age and ability to acquire new responses have failed to yield significant age differences in performance (1, 2, 5). An examination of these studies indicates that they usually involve simple learning tasks acquired with relatively massed trials. Furthermore, most of these studies are concerned only with a rather limited age range of Ss. The purpose of the present investigation was to extend the study of age variations in acquisition ability by examining relationships among avoidance performance, distribution of training trials, and learning task difficulty, and by including a group of very aged Ss. Specifically, it was hypothesized that ability to acquire avoidance responses varies with age only when training trials are relatively massed and when the to-be-learned task requires a delayed response. Results of previous research by the present author (3) indicated that increasing the intertrial interval improves performance of old or immature rats, but not performance of young adult Ss. However, other researchers (6) observed that both young adult and immature rats acquired a maze more readily with a 30-minute than with a 30-second intertrial interval.

B. METHOD

1. Subjects

Ss consisted of 270 rats of Long-Evans stock, one-half of them males, equally divided among three groups aged 30, 150, and 730 days at the beginning of the study. Ss were housed in groups of four in wire cages and were maintained on *ad lib* rations of Rockland Rat Diet, vegetables, and water.

2. Apparatus

The apparatus consisted of a test chamber $29\frac{1}{2} \times 17 \times 4\frac{1}{2}$ inches high mounted on a grid of $\frac{1}{4}$ -inch steel bars. Two clear Plexiglas restraining walls

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divided the chamber into two end compartments $10\frac{1}{2} \times 17 \times 4\frac{1}{2}$ inches each and a center compartment $8\frac{1}{2} \times 17 \times 4\frac{1}{2}$ inches. Each end compartment could be divided into two compartments, $10\frac{1}{2} \times 8\frac{1}{2} \times 4\frac{1}{2}$ inches, by aluminum dividers which were moved into place by means of levers. Thus each end compartment served as a start box when the aluminum dividers were removed, or as a choice discrimination chamber when the dividers were in place. The Plexiglas screens were also raised by levers, allowing the *S* to respond at the appropriate time. Each of the four discrimination chambers was equipped with a 5-watt incandescent bulb which was illuminated independently and served as discriminand.

One section of the floor in each of the discrimination chambers pivoted when *S* stepped on it, automatically terminating the conditioned stimulus (CS) and the shock (if presented). Other contacts lowered the restraining doors and raised the dividers, changing the whole end compartment into a start box. At the same time the other dividers moved into place in the opposite end compartment, changing it into two discrimination chambers.

Shock was supplied by a 110-120 volt AC power supply which delivered a foot shock intensity of 2.0 magnitude through a grid shock scrambler.

3. *Conditioning Procedures*

Ss of each sex within each age group attempted either a simple avoidance, discriminated avoidance, or delayed discriminated avoidance task. Training trials for *Ss* attempting each task were spaced 10 seconds, one hour, or four hours apart. All *Ss* ran 40 trials. *Ss* of each sex were randomly assigned to task and trial distribution groups.

a. Simple conditioned avoidance problem. On each trial *S* was placed in one compartment of the apparatus where he remained for 10 seconds. Lights in both sections of the opposite compartment were then turned on and served as the CS. Simultaneously the Plexiglas screen was raised, allowing *S* to respond. Five seconds later, the unconditioned stimulus (US), shock to the feet, was presented unless the *S* had entered either section of the opposite compartment during the CS-US interval. Both CS and US were terminated when *S* entered the lighted compartment, or 10 seconds after onset of the US, whichever occurred first. Entry of either section of the compartment prior to presentation of the US was recorded as an avoidance.

b. Discriminated avoidance problem. Procedures for this problem were similar to those described above, except that *S* was required to make a brightness discrimination in addition to shock avoidance. The CS consisted of a light appearing in one of the two sections of the compartment opposite *S* at

the beginning of each trial. The section to be lighted on any given trial was randomly determined. Entry of the lighted section prior to appearance of the US constituted avoidance.

c. *Delayed discriminated avoidance problem.* Procedures for this problem were identical to those described above, except that the CS was presented for five seconds while *S* was restrained from responding by the Plexiglas screen. After this interval the CS was terminated and two seconds later the screen was raised, permitting *S* to respond. Five seconds after the screen was raised, the US was presented unless *S* had entered the section that was previously lit, or 10 seconds after US onset. Entry of the section where the CS had previously appeared prior to US onset was scored as an avoidance.

C. RESULTS

Mean avoidances performed by all *Ss* were analyzed by a $2 \times 2 \times 2$ factorial analysis of variance. Significant values of *F* were obtained for problem ($F = 25.21$, $df = 2/243$, $p < .001$); age ($F = 10.03$, $df = 2/243$, $p < .01$); trial distribution ($F = 6.21$, $df = 2/243$, $p < .01$); interactions between problem and age ($F = 8.30$, $df = 4/243$, $p < .01$); problem \times trial distribution ($F = 4.21$, $df = 4/243$, $p < .01$); age \times trial distribution ($F = 5.86$, $df = 4/243$, $p < .01$); and problem \times age \times trial distribution ($F = 3.01$, $df = 8/243$, $p < .01$). Significant mean differences among groups were determined by Duncan Multiple Range Tests. Mean avoidances performed by all *Ss* are presented in Table 1.

The highly significant *F* value for problem indicates that the learning tasks actually did differ in difficulty. *Ss* of all ages with all intertrial intervals performed more poorly on the delayed avoidance than on the simple avoidance task. Level of performance on the discriminated avoidance task was intermediate between these. When trials were spaced 10 seconds apart, means for *Ss* in all age groups were smaller than means for other intertrial intervals.

Performance with longer intertrial intervals was significantly affected by age and task difficulty. On the simple avoidance problem, means obtained by *Ss* of all ages with one and four hour intervals were similar. On the discriminated avoidance task, means for 30- and 730-day-old *Ss* with the four-hour trial distribution were significantly larger than those for *Ss* of similar ages when trials were spaced 10 seconds or one hour apart. On the delayed avoidance task, performance of 30- and 150-day-old *Ss* with the four hour interval was significantly better than their performance at shorter intervals. Delayed avoidance means obtained by 730-day-old *Ss* were similar under all trial distributions.

No significant sex differences were noted. However, 150-day-old and 730-day-old female *Ss* tended to obtain higher means than did males on discriminated and delayed avoidance task with one- and four-hour intertrial intervals.

D. DISCUSSION

The results indicate that acquisition of avoidance responses varies as a function of age, distribution of trials, and problem difficulty. Age differences in avoidance performance are minimal when trials are widely spaced and when the task is relatively easy. These findings fit well with results of previous research (3, 6). They also suggest sources of conflicting results obtained in studies of age differences in acquisition of avoidance responses (1, 5).

Performance of aged *Ss* (730-day-old) did not differ significantly from that of immature animals except on the delayed avoidance task with a four-hour intertrial interval. Apparently, old *Ss* were incapable of making a delayed response under conditions of this experiment. This finding suggests that aged *Ss* may be handicapped by an immediate memory deficit or by an inability to pay attention to an absent stimuli.

Ss of all ages obtained higher avoidance means at relatively longer intertrial intervals than under massed trials (10 seconds apart). Performance of *Ss* of extreme ages was most sensitive to increases in length of the intertrial interval. For example, performance deficits among 30- and 730-day-old *Ss* on the simple avoidance task occurred only when trials were spaced 10 seconds apart. Deficits occurring on the discriminated avoidance problem among 730-day-old *Ss* disappeared when trials were spaced four hours apart. However, on the delayed avoidance task, even performance of 150-day-old *Ss* improved with increases in intertrial interval from one to four hours.

A possible basis of the present findings is that attention, motivational, or fatigue decrements are associated with massed trials, and that *Ss* of extreme ages are more susceptible than were the 150-day-old *Ss* to these effects. For example, the only uniform performance noted over all trial distributions was among 150-day-old *Ss* attempting the simple avoidance problem. If attention or motivational differences characterize *Ss* of different ages, it is difficult to explain why these differences appear only on particular learning tasks. Such decrements may also be associated with difficult tasks among *Ss* of all ages.

An alternative explanation of these findings is that learning deficits appear when trials are sufficiently massed as to interrupt consolidation of posttrial neural processes. The performance of *Ss* of extreme ages under different distributions of trials suggests that length of the consolidation interval may be

determined in part by age. That length of the consolidation interval may also vary with task difficulty is suggested by findings that, on the more difficult tasks, Ss of most age groups performed better with increased intertrial intervals.

Regardless of their basis, these findings suggest that careful attention must be paid to the nature of the learning task and to distribution of training trials before conclusions can be drawn regarding age differences in learning ability.

E. SUMMARY

Rats of three different ages acquired either a simple-, discriminated-, or delayed-avoidance problem with either 10-second, one-hour, or four-hour intertrial intervals. Performance of rats of extreme ages (30 and 730 days old) was inferior to that of 150-day-old Ss only when trials were relatively massed and when the task was relatively difficult. Ss with all age groups attempting the delayed avoidance problem performed best with the longest intertrial interval. The results suggest that age differences in acquisition depend partially on distribution of training trials and difficulty of the learning task.

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THE EFFECTS OF DIFFERENTIAL POSTWEANING ENVIRONMENTS ON LATER BEHAVIOR IN THE RAT*

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A. INTRODUCTION

The hypothesis that infantile stimulation affects later behavior has received a great deal of attention in the past two decades. Hebb (5), in an exploratory search comparing 25 cage-reared dogs with seven reared at home as pets, found that the group with the greater infant experience was definitely superior in performance. He presented evidence to show that this was not due to a motivational taming effect, concluding (a) that the effect of infant experience on adult behavior is lasting; and (b) that this difference may not be detectable in rote learning scores, but will appear when a method is used having an index based on a large number of problems that some normal animals solve promptly. A close analysis of the data concerning the effects of postweaning environmental manipulations on adult behavior indicates several trends.

1. Animals given early postweaning experience make significantly fewer errors (more correct responses) than do animals raised under neutral (laboratory cages) or restricted (visual or motor) conditions. Bingham and Griffiths (1) found significantly fewer errors when animals were raised in wide (spatial) environments as opposed to those raised in neutral or restricted environments. Similar results were reported by Denenberg and Morton (2).

2. Animals raised in "enriched" environments, characterized by the presence of objects affording extra visual stimulation, are superior to animals raised in neutral or restricted environments, based on the number of trials to a learning criterion. Bingham and Griffiths (1), Hebb (5), Hymovitch (8), and Woods (10) have all reported similar results.

3. Animals raised in "enriched" environments should be significantly faster (time per trial) than animals raised in neutral or restricted environments, due to a greater variability and activity (9), less exploratory behavior

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and overall curiosity (11), and greater use of perceptual cues in the testing apparatus (3, 8).

The purpose of this experiment was to determine the effect of three different types of spatial or wide environments upon learning ability as measured by the mean number of errors, time, and trials to a predetermined learning criterion. Two hypotheses were made concerning the results:

1. Animals raised in the enriched environment (with extra visual stimulation in the cage) should be superior to the animals raised in a maze and the animals raised in the restricted environments in all three measures.

2. Animals raised in the restricted environment (restricting motor activity but not normal visual stimulation) should be inferior in performance in all three measures to the other two groups.

No specific hypothesis was made concerning the performance of the maze-reared animals, although it was felt that they should be superior to the restricted group but inferior to the enriched group on all three measures.

B. SUBJECTS

The *Ss* used in this study were 21 experimentally naive Wistar albino rats obtained shortly after weaning from the Manor Farm Colonies. At the age of 25 days the animals were divided into three groups of seven rats each.

C. APPARATUS

Group A, the restricted group, lived in a wire community cage which measured 20 by 20 by 12 inches. A movable Plexiglas roof was placed in the cage approximately four inches above the floor, thus eliminating any climbing experience. Group B, the maze group, lived in a similar community cage. Inserted into this living area was a fiberboard maze consisting of several blind alleys, enclosed spaces, and runways, all approximately six inches high. Climbing experience was permitted in this manner, although none was ever noted by the *E*. Group C, the enriched group, was placed in a slightly larger wire community cage measuring 24 by 30 by 15 inches. This cage contained metal tubes, logs, a rubber football, a metal propane gas cap, and an elevated platform, in order to afford the *Ss* ample opportunity for varied activity and experience.

Weekly cleaning during a 50-day maturation period afforded adequate handling to acquaint the *Ss* with the *E*, while leaving them relatively free from individual bias. In order to assure uniformity in all groups, the lights in the living quarters and the experimental room were left on at all times throughout the 90-day experimental period. In addition, the three cages were

placed in such a way as to eliminate observation of the animals in one cage by those of another.

The trials were run in a Hebb-Williams maze (6). Each runway was five inches wide and six inches high. The top of the entire apparatus was covered by a piece of framed hardware cloth, hinged at the rear for easy opening. The maze itself was divided into 36 five-inch sections and Hall's (4) criterion for number of defecations in a four-minute period was used as an index of emotionality.

D. PROCEDURE

For the first 43 days the *Ss* had food and water continually present. Seven days before the actual onset of testing, all *Ss* were put on a 22-hour food deprivation schedule. The day before testing began, each *S* was placed in the goal box with two food pellets present. After 15 seconds *Ss* were removed and placed in a wire restraining cage for one minute before being returned to their home cage.

Beginning on approximately the 75th day of age, each *S* was run 10 successive trials per day. A trial terminated upon entrance into the goal box. Between trials the *S* was placed in the wire restraining cage for one minute. The reward consisted of two .37 mg pellets of food which were placed in the goal box before the trial began. Upon entrance of an *S* into the goal box, a door was dropped behind it to prevent re-entrance into the maze proper. Testing was continued for each *S* until it had run to a criterion of eight correct responses (out of 10 trials) per day for two consecutive days. A correct response was recorded when the *S* ran the entire maze without error; that is, taking the shortest route to the goal box without stopping to explore irrelevant areas of the maze.

One supplementary measure of learning was obtained. Each *S* was timed for its trials, taken from departure out of the start box until the goal-box door was dropped.

E. RESULTS

The results of the experiment in most instances supported the original hypotheses.

There was only one defecation during the entire testing period. For this reason it was decided that the testing situation did not constitute an emotional experience to the *Ss*.

1. *Time to Learn*

Figure 1 shows the mean running time per group during the nine-day period required before all *Ss* met the learning criterion. Results of analysis

of variance, summarized in Table 1, showed the results of differential rearing to be significant at the .05 level. Group B (maze-reared) and C (enriched) Ss ran significantly faster on learning trials than did Group A (restricted)

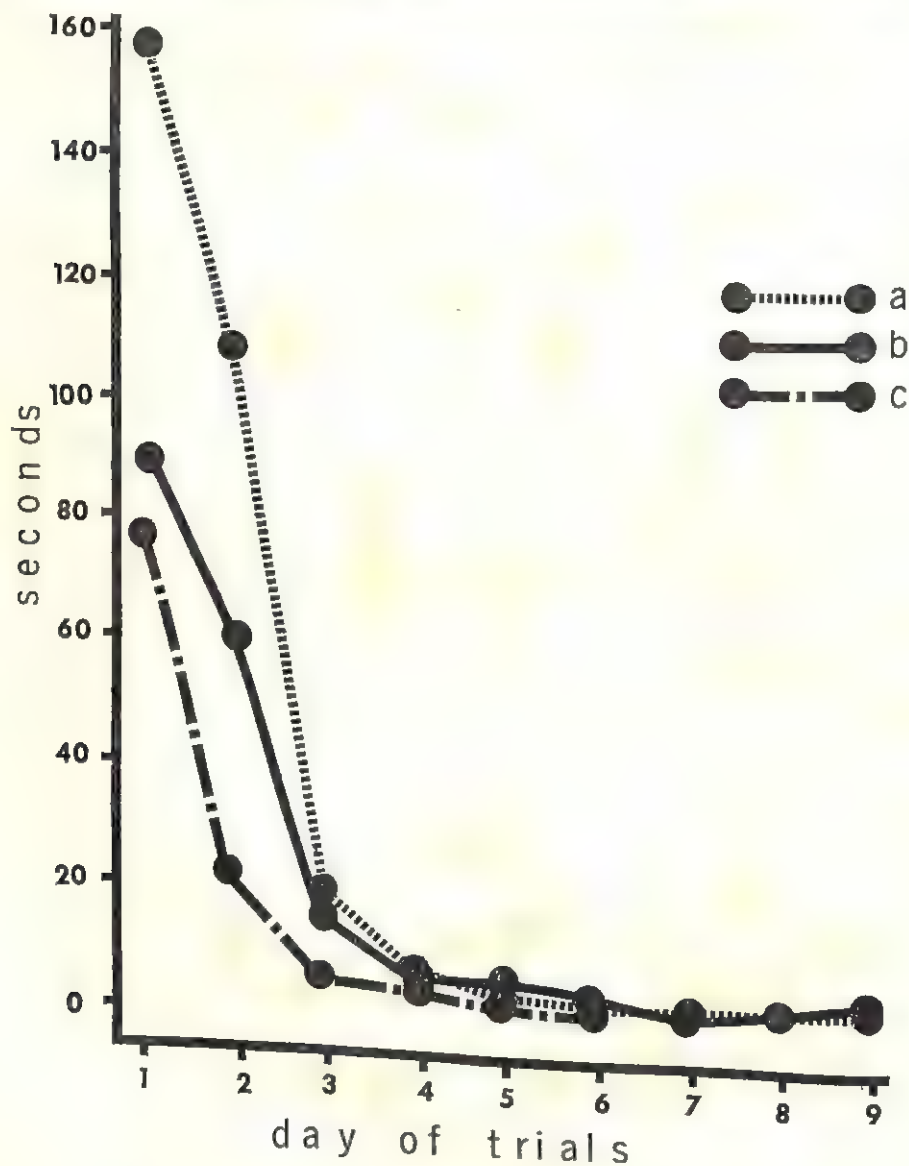


FIGURE 1
MEAN RUNNING TIME PER GROUP FOR NINE TRIAL DAYS

($t = 2.895$, $p < .01$; $t = 4.603$, $p < .0005$; $df = 12$, respectively); but the groups did not differ significantly from each other although the difference was approaching significance in the predicted direction ($t = 1.708$, $p < .10$).

2. Trials to Learn

Results of analysis of variance, summarized in Table 2, showed the effects of differential rearing to be significant at the .001 level. There was no difference between means in Groups A and B, while Group C required significantly fewer trials to learn ($t = 4.429$, $p < .005$, $df = 12$) than did the other two groups.

3. Errors to Learn

Figure 2 shows the mean errors per group for each successive block of 10 trials before all Ss met the learning criterion. Results of analysis of variance, summarized in Table 3, showed the effects of differential rearing to be significant at the .05 level. Group C Ss made significantly fewer errors than did Group A Ss ($t = 2.972$, $p < .01$) during learning, while there was no significant difference between the other groups. It should be noted, however, that the difference between Groups A and B was approaching significance in the predicted direction ($t = 1.697$, $p < .10 > .05$).

Table 4 summarizes the results of the tests for t -ratios and Table 5 summarizes the means of the three groups for the dependent variable measures.

TABLE 1
SUMMARY OF ANALYSIS OF VARIANCE OF MEAN RUNNING TIMES

Source of variation	<i>df</i>	<i>MS</i>	<i>F</i>
Between groups	2	1924.44	5.418*
Within groups	18	355.19	

* $p < .05$.

TABLE 2
SUMMARY OF ANALYSIS OF VARIANCE OF MEAN TRIALS TO LEARN

Source of variation	<i>df</i>	<i>MS</i>	<i>F</i>
Between groups	2	1219.05	13.01*
Within groups	18	93.65	

* $p < .001$.

TABLE 3
SUMMARY OF ANALYSIS OF VARIANCE OF MEAN ERRORS TO LEARN

Source of variation	<i>df</i>	<i>MS</i>	<i>F</i>
Between groups	2	270,686.64	4.428*
Within groups	18	61,128.98	

* $p < .05$.

TABLE 4
SUMMARY OF *t*-RATIO TESTS

Dependent variable	A—B	A—C	B—C
Running time in seconds	2.895**	4.603***	1.708*
Error scores	1.697*	2.972**	1.365*
Trials		4.429***	4.429***

Note: A = the restricted group, B = the maze group, and C = the enriched group.

* $p < .10$.

** $p < .01$.

*** $p < .005$.

TABLE 5
SUMMARY OF MEAN TOTALS PER SUBJECT

Dependent variable	Group A	Group B	Group C
Running time in seconds	2078.00	1840.20	1110.00
Error scores	630.71	418.29	237.86
Trials	72.90	72.90	50.00

F. DISCUSSION

The results of this experiment have, for the most part, supported the hypotheses of the present *E* and Hebb (5), but appear somewhat contrary to those formulated by Hymovitch (8) and Bingham and Griffiths (1). In the present study all three groups were reared under similar conditions of total area, yet the Group C Ss clearly excelled the other groups in all but two measures. There was no significant difference between Groups B and C in mean number of errors or mean running time. Examination of the learning curve illustrating mean running time (see Figure 1) reveals a noticeable between-group diversity through the seventh block of trials. It would appear that the Bingham and Griffiths hypothesis—that richness of a wide environment is not related to superior maze learning—is untenable in view of the present data. The Group B Ss had a possible advantage over Group C Ss in that their home environment was quite similar to the testing apparatus, but apparently this was not sufficient to overcome the lack of extra visual stimulation afforded Group B. This would lend support to Hoffman's (7) hypothesis that the importance of visual stimulation and physical space in determining later behavior are about equal.

The longer time-to-learn required by the maze group Ss compares favorably with the results reported by Forgays and Forgays (3) where their Ss raised in a free environmental situation without playthings were slower learners than those raised in a free environment with playthings. The apparent disagreement between this present study and that of Hymovitch (8) may be attributed to the fact that his Ss raised in a free environment situation were

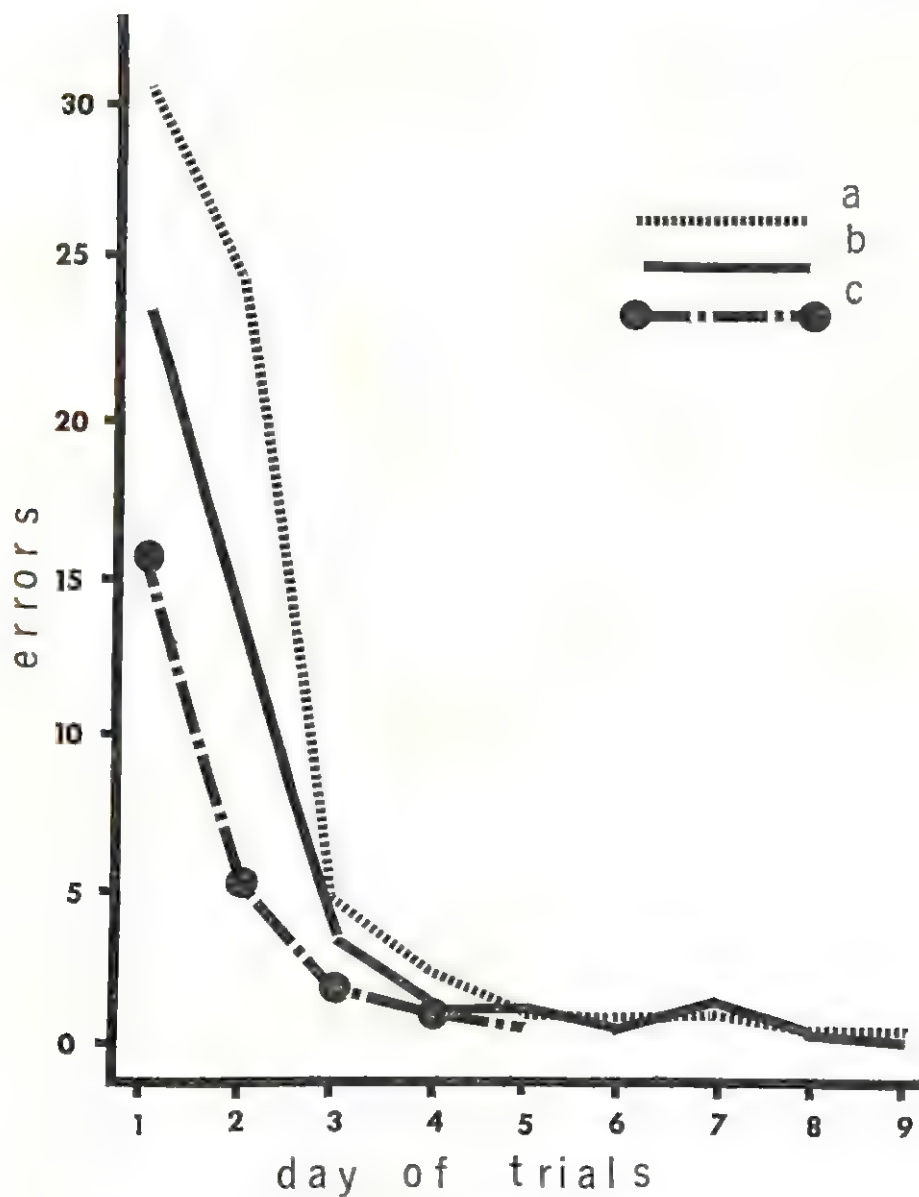


FIGURE 2
MEAN ERRORS PER GROUP FOR EACH SUCCESSIVE BLOCK OF 10 TRIALS
BEFORE ALL SUBJECTS MET THE LEARNING CRITERION

actually limited as to their motor activity although being afforded extra visual stimulation, while the maze rats in this study were not so restricted.

It would appear, then, that a slight modification of the position taken by Hoffman (7) is necessary in explaining adult behavior on the basis of postweaning environmental manipulations. Both physical space and visual perception are important, but the role of the latter is somewhat more significant than that of the former. Support for this hypothesis comes from three areas: first, the results of the present study showing the maze group to be somewhat inferior to the enriched group; second, the apparent hindrance of learning found upon rotation of the testing apparatus (3); and third, the conflicting results with regard to the effect of motor restriction.

The results of this experiment also raised the problem of independent variable selection—its influence on interpretation of the data. It is obvious that the three measures used in this study do not correlate perfectly and one may, therefore, obtain different conclusions depending on which variables are utilized.

G. SUMMARY

Twenty-one native albino rats were used as Ss in an experiment designed to show the effects of differential postweaning environments, all characterized as wide or spatial, upon adult performance in a Hebb-Williams maze. Three groups—enriched environment, maze environment, and restricted (motor) environment—were required to perform to a pre-established level of learning. One-way analysis of variance showed significant effects ($p < .05$; $p < .001$; $p < .05$, respectively) for all three measures. The enriched group was significantly faster in running time than both the maze group ($p < .10$) and the restricted group ($p < .0005$); made fewer errors ($p < .10$, $p < .01$, respectively); and required fewer trials to meet the learning criterion ($p < .0005$, $p < .0005$, respectively). The maze group, in addition to the above results, was found to be significantly faster ($p < .01$) and to make fewer errors ($p < .10$) than the restricted group. The results confirmed the hypotheses that the enriched group should be better on all three measures than the other two groups, and the restricted group should be inferior in all three measures to the other two groups.

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SERIAL VERBAL LEARNING AND TRANSFER IN RETARDED AND NORMAL CHILDREN*

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A. INTRODUCTION

The problem of whether there is a difference between the learning ability of normal and mentally deficient subjects in verbal learning has not been fully investigated. There appear to be only four published studies in the literature dealing with the verbal learning of mentally retarded subjects. Two of these studies were by McCulloch *et al.* (2, 3) and a third was by Sloan and Berg (4). In these three studies only mentally deficient subjects were used in a serial learning task. They all concluded that word learning was related to mental age (MA), but not to chronological age. Cassel (1), who measured the performance of normal as well as retarded subjects on various serial learning tasks, concluded that once adjusted to the task, and with MA held constant, there is little or no difference in learning ability.

The present study was designed to compare the performance on a learning task of retarded and normal subjects matched for mental age. In addition, a study of effect of list similarity on new learning was carried out to determine if normals and retardates behaved differentially in terms of transfer.

B. METHOD

1. Subjects

The Ss consisted of four groups equated for MA. There were 24 white male Ss selected from the East Baton Rouge School system with MAs between 6 years and 9 years. These students were in the first through the fourth grades. Twenty-four Ss were from Pinecrest State School, which is a state-supported school for the retarded. None of the special clinical groups found at Pinecrest (Mongoloids, nor persons with gross physical disabilities) was included in the experimental population. The MAs of all Ss were determined by the Chicago Non-Verbal examination, which was administered one week prior to the presentation of the learning task. Twelve retardates and 12 normal

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¹ Now at Memphis State University.

children were randomly assigned to each of the two experimental conditions. The MA and chronological age characteristics of the *Ss* are presented in Table 1.

TABLE 1
MEAN LIFE AGE AND MEAN MENTAL AGE FOR EXPERIMENTAL GROUPS

List A Mean mental age	List B Mean life age	List C Mean mental age	List B Mean life age
<i>Retarded</i>			
6.98 (<i>SD</i> = .59)	21.60 (<i>SD</i> = 5.74)	7.24 (<i>SD</i> = .22)	19.58 (<i>SD</i> = 5.10)
<i>Normal</i>			
7.81 (<i>SD</i> = .74)	8.25 (<i>SD</i> = .69)	7.69 (<i>SD</i> = 1.03)	8.95 (<i>SD</i> = .83)

2. Materials

Four serial lists were used. Three of these lists consisted of drawings of common objects (the practice list and Experimental Lists A and B), and the fourth list consisted of patches of colors (List C). The practice list consisted of three drawings. Experimental List A contained eight drawings; Experimental List B, the test list, contained the same eight drawings as found in List A, but presented in a different order; and the Experimental List C consisted of eight colors. These lists were presented by a memory drum with a two-second exposure time.

3. Procedure

S was first shown a series of pictures that included the objects on the lists, and was asked to name them. If he was unable to name an object, *E* identified the object for him.

After *S* was familiar with the objects, he was given the practice list, which consisted of three pictures, and was instructed in the anticipation method. When *S* had reached the criterion of one perfect trial on the practice list, he was randomly assigned to learning either List A or List C. The learning took place in a single session with *S* required to learn to a criterion of one perfect recitation.

Once *S* had learned either List A or List C, he was given the test List B and required to learn it to a criterion of one perfect trial.

C. RESULTS

The response measure was the number of trials required by *S* to reach a criterion of one perfect recitation. The mean number of trials to reach the criterion for the experimental groups on the experimental lists and test list are shown in Table 2.

TABLE 2
TRIALS TO CRITERION SCORES FOR EXPERIMENTAL GROUPS ON LEARNING
THE EXPERIMENTAL LISTS AND TEST LIST

List A Mean	List B Mean	List C Mean	List C Mean
<i>Retarded</i>			
20.90 (<i>SD</i> = 10.12)	20.30 (<i>SD</i> = 11.55)	19.50 (<i>SD</i> = 10.90)	17.17 (<i>SD</i> = 8.27)
<i>Normal</i>			
13.27 (<i>SD</i> = 4.11)	12.09 (<i>SD</i> = 4.48)	13.25 (<i>SD</i> = 3.98)	9.50 (<i>SD</i> = 4.14)

The difference between normals and retardates on initial learning was tested by *t*-tests. The *t*-test difference between the mean trials to criterion for normals and retardates on Experimental List C was 1.75, which was significant at the .10 level. For Experimental List A, the *t*-test was 2.20, significant beyond the .05 level.

A double classification analysis of variance of difference scores between the initial experimental list and the test list was computed to determine if there was a differential transfer effect. The summary table of the analysis is reported in Table 3. These results indicated that there was a significant differ-

TABLE 3
ANALYSIS OF VARIANCE OF DIFFERENCE SCORES BETWEEN EXPERIMENTAL AND TEST LIST

Source	<i>df</i>	<i>MS</i>	<i>F</i>
Treatment	1	150.54	6.57*
Normal-retarded	1	11.04	.48
Treatment \times normal-retarded	1	2.42	.10
Within	44	22.90	
Total	47		

* $p < .05$.

ence between the effect that learning List A and List C had on the number of trials required to learn List B. Once controlled for initial learning, the difference between normals and retardates was not significant.

D. DISCUSSION

The number of trials required to reach a criterion of one perfect recitation was significantly greater for the retardate group than for the normal group. This was not in line with the earlier findings (1, 2, 3, 4). One difference between the present study and earlier studies was the task. In the studies referred to above, the task consisted of learning nonsense syllables, which required the *S* to have reading ability. Cassel (1), for example, eliminated

over 100 retarded Ss because they were unable to read. This would mean the Ss used in these studies would be in school even though they were institutionalized. In the present study, only a few of the retardates were in school. This could account for the difference, because with the retardate group in the present study learning situations were relatively strange. The normal group, on the other hand, attended regular classes and was subjected to learning problems every day. Thus, the normal Ss were more familiar with methods of attacking a learning task than were the retarded Ss.

Another factor that could account for part of the difference between normals and retardates was the apathy displayed by many of the retarded Ss. This appears to be one of the dangers of institutionalization, in that it destroys the drive of the patient. In addition to apathy, the retarded Ss displayed fear of the Psychology Department at Pinecrest State School because many Ss tested in the department are transferred to other institutions, and patients feared this. Thus, apathy and fear reduced the motivation of retarded Ss.

The similarity of Experimental List A and List B inhibited the ability of both retarded and normal Ss in learning the test list. List C, which consisted of colors, provided practice for the Ss in how to learn, and when the Ss were presented with the test list there was a significant improvement in learning.

It would appear from these data that, when controlled for level of initial learning, there is no difference between the normal and retarded Ss in transfer of training. The same trends occurred with both the retardate and normal groups.

E. SUMMARY

The purpose of the present study was to assess differences in serial learning between normal and retarded Ss with MA controlled, and to determine if there was a difference in transfer effect. The Ss consisted of 24 normal children with an MA between 6 and 9 years of age, and 24 retarded Ss with comparable mental ages.

The task consisted of four lists presented by means of a memory drum. These lists were to be learned by the method of anticipation. The two experimental conditions were designed to create a difference in the transfer effect. In the first condition the initial list and the test list were similar and, thus, initial learning should inhibit new learning. In the second condition, the two lists were not similar, so that *E* anticipated greater facilitation in learning the test list.

A significant difference in initial learning between the normal group and retardate group was obtained, but no difference in transfer.

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SIBLING ASSOCIATION, FAMILY SIZE, AND
COGNITIVE ABILITIES*¹

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A. INTRODUCTION

In several earlier investigations of the eight types of two-child families and the 24 types of three-child families, these investigators demonstrated that responses to inventories assessing masculinity-femininity, anxiety, and interests varied systematically with ordinal position and sibling sex status (7, 13, 14). In an attempt to discover whether these family structural effects were of an even more coercive power in development than previously shown, a study was made of relations between the eight types of two-child family positions and scores on the American College Entrance Examination (ACE). It was found, as expected, that girls were superior to boys on language scores and boys superior to girls on quantitative scores. In addition, first-borns of both sexes were superior to second-borns of both sexes on language scores, the relations being more marked for males than for females. Second-born females were higher than first-born females on quantitative scales (8). There was, however, no general effect of sibling sex status. That is, boys (or girls) with sisters were not, in general, significantly higher on language scores than boys (or girls) with brothers, nor were the latter, in turn, higher on quantitative scores. In these two-child families, therefore, ordinal position, not sibling sex status, exerted the only systematic effect on cognitive phenomena assessed in this way. The results were consistent with those of a number of earlier investigators (2, 5, 15).

The present investigation extends the study of ordinal position and sibling sex status effects on cognitive abilities to the 24 types of three-child family positions. The earlier comparison of three-child families with two-child families would lead us to expect considerable differences might ensue as a result of the family structural change (7).

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B. METHOD

Data on the ACE (3) were obtained for 600 male and female members of the 24 combinations of the three-child family ($N = 25$ each). The ACE is administered at the time of entry to college, for advising purposes. There are no selective criteria for college entry, except high school graduation. In practice, most students are from the upper 50 per cent of their graduating high-school classes. The Ss were predominantly sophomore college students. The sample contained 25 each of F1FF, F1FM, F1MM, F1MF, M1MM, M1MF, M1FF, and M1FM, and like categories for the second-born and third-born boys and girls. The notation states the sex and position referent, with the number following the S indicating the subject's ordinal position. Thus, MF2M refers to a second-born female (the S) with an older and younger brother, and so on. These groups did not differ in age (median for all groups was 19 years), and 95 per cent of all ordinal groups were in the 18-20 year range.

When the groups were compared in terms of their fathers' occupation on a manual to nonmanual socioeconomic break, it was found that there were no significant differences between first-born, second-born, and third-born girls. The proportion of manual to nonmanual fathers was about 1:2 in each category. In the boys' groups, however, the proportions of manual to nonmanual fathers steadily changed, with a ratio similar to that for the girls in the first-born boy families (i.e., a 1:2 break on this dimension), but a ratio of approximately 2:1 manual to nonmanual in the third-born boy families ($1B < 2B$, n.s.; $1B < 3B$, $p < .01$; $2B < 3B$, n.s.). When all girls were compared with all boys on the same manual to nonmanual ratio, there was a directional difference favoring a higher proportion of nonmanual fathers for the girls than for the boys.

Since all data were presented in percentile form, the median test (11) and χ^2 were used throughout the analysis. As a measure of the characteristic, male-quantitative (Q), female-language (L) differences, $Q > L$ and $L > Q$ ratios were included in addition to the Q, L, and T (total) scores the ACE provides.

C. RESULTS²

1. Ordinal Position Alone

Tables 1 and 2 present the Q, L, and T scores and the $Q > L$ and $L > Q$ ratios for the entire sample. Several findings are immediately apparent. Gener-

² The authors are indebted to Miss Judith Griffiths for her assistance in the present study.

TABLE 1
 MEDIAN SCORES AND FREQUENCY OF $Q > L$ AND $L > Q$ RATIOS
 ON ACE (Q,L,T) BY ORDINAL GROUPING
 (Females)

Group	Q	L	T	$Q > L$	$L > Q$	
F1FF	56	54	58	9	16	
F1FM	53	51	53	12	13	$Q > L = 45$
	(56)*	(54)	(56)			
F1MM	60	71	66	11	14	$L > Q = 55$
F1MF	49	45	45	13	12	
FF2F	49	54	56	11	14	
FF2M	74	49	64	18	7	$Q > L = 55$
	(67)	(56)	(60)			
MF2M	71	67	72	13	12	$L > Q = 45$
MF2F	64	54	56	13	12	
FFF3	49	63	55	14	11	
MFF3	45	54	53	10	15	$Q > L = 59$
	(54)	(54)	(55)			
MMF3	71	67	70	19	6	$L > Q = 41$
FMF3	41	35	36	16	9	
Totals	60	54	58	159	141	

Note: Q = male-quantitative, L = female-language, and T = total scores provided by the ACE.

* Numbers in parentheses represent the median score for the four combined groups: e.g., (56) is the combined median for all first-born females ($N = 100$) on Q scores.

TABLE 2
 MEDIAN SCORES AND FREQUENCY OF $Q > L$ AND $L > Q$ RATIOS
 ON ACE (Q,L,T) BY ORDINAL GROUPING
 (Males)

Group	Q	L	T	$Q > L$	$L > Q$	
M1MM	67	51	58	17	8	
M1MF	67	42	63	17	8	$Q > L = 70$
	(67)	(49)	(61)			
M1FF	53	49	56	16	9	$L > Q = 30$
M1FM	77	49	67	20	5	
MM2M	67	40	50	22	3	
MM2F	74	56	68	18	7	$Q > L = 78$
	(67)	(47)	(57)			
FM2F	53	35	44	16	9	$L > Q = 22$
FM2M	77	47	63	22	3	
MMM3	45	29	35	19	6	
FMM3	74	35	47	19	6	$Q > L = 77$
	(71)	(40)	(46)			
FFM3	71	49	56	19	6	$L > Q = 23$
MFM3	77	51	63	20	5	
Totals	69	56	47	225	75	

Note: Q = male-quantitative, L = female-language, and T = total scores provided by the ACE.

ally, ordinal position (OP) in the three-child family appears unrelated to performance on the ACE, a finding in contradiction to that noted with the two-child family. For T scores, no significant differences obtain when comparing all first borns (1B) with second borns (2B) and third borns (3B). Several results, however, are directional. For females $2B > 3B$ ($p < .10$), 1B males look superior to 2B males, who look superior to 3B males, but none of these differences on total scores is significant ($1B > 3B$, $p < .10$). Similarly, there are no significant results for either males or females on Q and L scales when the total ordinal groups (1B, 2B, 3B) are compared with each other.

When linguistic and quantitative ratios are compared, however, 1B girls as a group are higher than nonfirst borns on linguistic tendencies ($1B > 2B$, $p < .10$; $1B > 3B$, $p < .05$). The differences between 1Bs, 2Bs and 3Bs does not achieve significance on the quantitative over language ratios, though the trend is for these quantitative tendencies to increase as we move down the family positions, 1B, 2B, 3B. Similar trends are noticeable in the male subjects' scores: that is, for language tendencies to decrease and quantitative tendencies to increase as a consequence of being later-born, but none of the differences is significant.

2. Ordinal Position and Sibling Sex Status

In view of the numerous comparisons necessary in this section, only the major findings will be presented. The most striking findings in the present study are the effects of male siblings on girls in 2B and 3B positions, and the effects on males of the presence of heterogeneous or homogeneous siblings.

With girl subjects, the presence of a male sibling, especially an older male, is related to elevations not only on Q scores, but on L and T scores also. Thus, where a comparison of all female triads (F1FF, FF2F, and FFF3) with one another on Q, L, or T yields no differences, the female triads with all male siblings (F1MM, MF2M, and MMF3) are higher on Q than the female triads, (F1MM *vs.* F1FF, n.s.; MF2M $>$ FF2F, $p < .01$; MMF3 $>$ FFF3, $p < .01$), and these female-male sibling triads are directionally higher on L also, although this contrast is not so marked (F1MM $>$ F1FF, $p < .10$; MF2M $>$ FF2F, $p < .10$; MMF2 *vs.* FFF3, n.s.). The presence of a male sibling appears to inflate Q and L scores, whether one or two male siblings are involved; though, by and large, two males have more effect than one (Q scores: FF2M $>$ FF2F, $p < .05$; MMF3 $>$ MFF3, $p < .05$; MMF3 $>$ FMF3, $p < .01$; L scores: F1MM $>$ F1FM; F1MM $>$ F1MF; MF2M $>$ FF2M; all at $p < .10$; T scores: MMF3 $>$ FMF3, $p < .02$; MMF3 $>$ MFF3, $p < .10$). A last set of examples illustrating the effects of males on Q scores,

particularly of the second and third-born females, are as follows: $MF2M > F1MM$, $p < .02$; and $MMF3 > F1MM$, $p < .05$. Among first-born females, the presence of a male sibling does not yield conspicuous changes in $Q > L$ or $L > Q$ ratios, but it does for 2B and 3B females. Thus, from Table 1 it can be seen that the $Q > L$ ratios are comparatively higher for $FF2M > FF2F$, $p < .05$; $MMF3 > MFF3$, $p < .01$; and $MMF3 > F1MM$, $p < .05$.

When the male groups are assessed, same sex or opposite sex siblings do not have the differential effects that have been noted in the female subject three-child families. Instead, with males, it is the homogeneity or heterogeneity of siblings that makes for a difference, regardless of their particular sex. Thus, males with diversified siblings (a male and a female) are superior to males with homogeneous siblings (two females or two males) on Q scores ($p < .001$) and on T scores ($p < .05$), but not on L scores.

In female three-child families, a contrary effect holds insofar as girls with homogeneous siblings are superior to girls with diversified siblings ($Q = \text{n.s.}$; L , $p < .05$; T , $p < .05$). This effect does not seem to be of the same origins as the opposite effect in boys, insofar as most of the variance is accounted for by those female triads that have two male siblings.

Other particular effects noticeable with males are as follows: Although, in general, sex of siblings makes no difference to males in 1B or 3B positions, it does make a difference in 2B positions where males with male siblings tend to have comparatively higher $Q > L$ ratios ($MM2M > MM2F$, n.s. ; $MM2M > FM2F$, $p < .05$; $FM2M > FM2F$, $p < .05$). The exceptionally low scores of a boy with two older brothers ($MMM3$) appears worthy of special note.

In the two-child families, females were superior to males on L scores, but in the present sample ($N = 600$), this is not the case. However, boys in general are superior to girls on Q scores ($p < .01$), as was the case for boys in the two-child family. Unlike the two-child families, girls in the three-child families are superior on T scores ($p < .001$). For the ratios, boys are higher on $Q > L$, while girls are higher on $L > Q$ ($p < .001$).

These various findings seem unaffected by the socioeconomic statuses of the groups, at least as assessed by the present manual to nonmanual break. There were no socioeconomic differences between the girls' groups, yet first-born girls tended to be superior on language scores. There were socioeconomic differences favoring first-born boys, but they were not superior on the ACE measures. The affect of males on girls and of diversified siblings on boys shows no relationship to these occupational distinctions.

D. DISCUSSION

The most salient finding in these results is that ordinal position, which is systematically related to differences on ACE scores in the two-child family (7), operates with much reduced effect in the three-child family. Further, this effect is maintained only for the female subjects. Some of the contradictory results in older studies in which the first born were compared with second born without regard for family size or sex may be accounted for by this finding (4).

The ordinal position differences that operate in two-child families affect only language scores systematically for both sexes, a finding also reported by Altus (2). In the present study of three-child families, only the female subjects maintain this difference in language scores between ordinal positions. These investigators would like to present the following tentative arguments to account for these observed differences. Females in general in two-child and three-child families do better than males at verbal tasks because of the modeling, and hence reinforcing, importance to them of verbal interaction with the mother. Such differences on verbal functions are maintained throughout later years (at least for the structural aspects of language) by females because this special interaction with the mother occurs during a critical period, one to three years, when language structures are being established. The additional language superiority of first borns, whether females or males, in the two-child family (and this holds for only children also) may be accounted for by the special dependency relationship that first borns have with their mothers, but which nonfirst borns do not have (6, 9, 10). Whereas first borns in two-child families can maintain this special relationship, first-born boys in three-child families are less likely to be able to do so because of the demands made on the mother by the two additional children. The first-born female who can take the position of mother surrogate with the two younger ones on the other hand, perhaps can, in that way, retain some of her original advantages. Such a role would not, however, be consistent with the other sex-typing influences on the first-born male, and he presumably loses out in his relationship with the mother. In the earlier work with two- and three-child families, in which responses to adjustment inventories were contrasted, similar marked changes were noted in the behaviors of first borns, depending on the presence of one or two younger siblings.

The second major result in this paper is that the quantitative and language scores of females in the three-child family are systematically affected by the presence of brothers, but that the males' cognitive scores in the three-child family are not systematically affected by the presence of sisters. While this

effect may be explained in terms of the dominance of male norms in the adult culture, it does not explain why female cognitive scores in the two-child families are not equally affected by the presence of male siblings (though their scores on the adjustment and interest inventories are affected by the presence of brothers). One possible interpretation is that in the two-child family each child can pair off with one of the parents, who continues, therefore, to be a dominant influence on his or her intellectual development. In three-child families, such matched pairing with the parents is not possible, and the children come to be both more independent of the parents and to depend upon each other more profoundly. The general effect of independence of the parents has been shown in a number of studies to lead to an increase in cognitive competences of a quantitative and an analytic sort (12), and it is these scores that are more affected in the present case. It may be speculated that increased skill in quantification occurs because independence as a personality trait more readily mediates an interest in stimuli emanating from a variety of sources—in particular, from the world of objects—and not just from one person. It is this interest in the object world that has often been said to underlie the superiority of boys in quantification and problem-solving. It follows that girls in the second- and third-born positions, because of less attention from the mother and because of their inability to play the surrogate mother role, are forced to be independent. This should make them more susceptible to modeling their cognitive behavior after their brothers who are already oriented in the direction of independence by sex-typing reinforcements. The subsidiary effect on their language scores is, of course, more difficult to explain in this way, unless we can assume the stimulation of the brothers has a generalizing effect.

The fact that boys in the three-child family are advantageously affected by contrasting siblings rather than homogeneous siblings is a surprising finding. We do not expect boys to be affected by girls. Their independence directs them rather toward their male peers in the school and neighborhood. In the earlier work with occupational interests, however, it was found that in the two-child families, children with opposite sex siblings, particularly boys, showed a much greater interest in expressive and technical creative occupations (engineer, physicist, mathematician, etc.) than did children with the same sex siblings (13). Perhaps results for both boys and girls can be subsumed to the statement that value conflicts in the available models have a stimulating cognitive effect on the subject, although this effect varies with the sex of the subject and the models. Thus, the major models for girls who are 2B and 3B are their mothers and older sisters. Such girls, however,

less attended to by those models and more independent in themselves, are also influenced by their independence-oriented brothers. Similarly, boys in the three-child family who are very independent of their parents are stimulated by a value conflict within the siblings themselves. Their masculine traits are enhanced by a brother, when contrasted with a tomboyish sister with her feminine traits. This value contrast theory is not new in the literature (1), though it obviously needs much further investigation in the present context.

In sum, most of the present effects can be explained in terms of the chain of consequences that occur with a structural change from a four-person family constellation to a five-person family constellation. This change leads to a basic alteration of parent-child relationships, and therefore to a change in child personality traits, and to a subsequent shift in the learning of competences. In the two-child family, the siblings affect each other's pattern of interests, but not those personality traits that appear to mediate the learning of competences. The special relationships between the two-child subjects and their parents appear to be the major determiners of language and quantitative skills. The three-child family, which becomes a group separate from the parents and which makes it more difficult for the mother to give such exclusive attention to all first borns (although girls retain that status through their surrogate usefulness), is more deeply affected by its own intragroup sibling influences than was the two-child family. The females are affected by the maleness of their siblings and the males by the diversity of their siblings. It has been suggested that the greater independence of all three-child family subjects mediates this greater, if differential, effect of the siblings.

E. SUMMARY

Data on the ACE for 600 college males and females were compared across the 24 types of three-child families, and contrasts were made with similar work on the eight types of two-child families. While male and female first borns have higher language scores in the two-child family, only female first borns have higher language scores in the three-child family. While two-child subjects are not systematically affected by the sex of their siblings, females in three-child families have their quantitative scores heightened by the presence of brothers. Male Ss in three-child families have their quantitative scores heightened by the presence of diverse, rather than homogeneous, siblings. Interpretations involve an examination of the way in which the structural differences between two and three-child families alter the children's relationship to the parents, and change the personality traits that mediate language and quantitative learning.

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CREATIVITY IN ART STUDENTS*¹

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A. INTRODUCTION

Creativity has been extensively studied and discussed. Four major research divisions have appeared: (a) criteria, (b) predictors, (c) training and development, and (d) external conditions that might influence creativity. The present study was concerned primarily with the third division, the development of creativity.

B. PROBLEM AND METHOD

The problem of this study was to investigate creativity in a group of art students. First, creativity and technical competence were studied to determine if they could be separated in children's paintings. Second, the study explored the development of creativity through childhood. The relation between the developmental patterns of creativity and technical competence was also investigated. The third part of the study involved an investigation of the behavior of the most and least creative children at all ages.

1. *Statement of Hypotheses*

Hypothesis 1—Creativity and technical competence can be measured and separated into two distinct variables in children's paintings, as judged by competent art critics.

Hypothesis 2—As assessed by the above method, technical competence increases gradually and steadily with age, whereas creativity remains relatively constant.

Hypothesis 3—Most and least creative art students differ at all ages on behavior related to (a) conformity, (b) universality of creativity, (c) use of free time, (d) emotional stability, and (e) kind of motivation.

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¹ Data for this study were taken from a thesis presented to the Graduate College of Iowa State University by Norma Trowbridge, in partial fulfillment of the requirements for the degree of Doctor of Philosophy, 1964.

2. Method

The first part of the investigation concerned judgments of children's art works measured for amounts of creativity and technical competence. Children from 3 to 18 years of age produced paintings that were judged by competent critics of children's art. From these data, patterns were developed showing the growth of creativity and technical competence with age.

The remainder of the investigation involved an intensive study of the children who rated highest and lowest on the creativity continuum. Four interviews were held for each of these children, with the child himself, his mother, his public school teacher, and his art instructor. Five general areas of behavior (listed under Hypothesis 3) were chosen to be discussed in each of the interviews.

The subjects were 75 children attending classes at a municipal art center in a city of about 200,000 population in the midwest United States. Of these, 31 were tuition students who paid a small fee for their lessons, and 44 were attending classes free. The nontuition students were given lessons upon recommendations by classroom teachers in their schools. The criterion for recommendation was interest rather than skill in art.

Children at the art center were divided for classes into five age groups: 3 to 5, 6 to 8, 9 to 11, 12 to 14, and 15 to 18 years. Fifteen children were chosen randomly from each age group as subjects for the study. This random selection resulted in the inclusion of 36 males and 39 females.

The staff of the art center gave considerable emphasis to artistic production. The subjects spent more time in classes than in gallery viewing. Individual approach and creative expression were encouraged. Classes had an atmosphere of freedom in exploring art media and learning design principles. While different teachers worked with different age groups, instructional practices were quite uniform. Similarity of philosophy and attitude of teachers at the center was engendered by original selection and by close daily contact; all had offices near one another and ate together. It was agreed that creativity, rather than technical competence, was the aim of instruction.

Paintings produced by the children over a semester period were saved. Rigid controls were followed throughout the time the paintings were produced, concerning (a) always having the same teacher in each age group, (b) seeking environmental conditions nearly identical, (c) using the same media, and (d) keeping extrinsic motivation as similar and constant as possible.

Two paintings produced by each child were selected at random from among paintings produced by him during the experimental period. As these 150 paintings were chosen, two from each of the 75 subjects, they were labeled

with a code number so that no names, ages, or other data appeared on them. The paintings were divided by random procedure into five groups, being ordered randomly within each group. The only purpose of these groupings was to change the order of the paintings between the critic's judgments. Thus a new random order was achieved between each judgment process for each critic. Since the paintings contained no identification except for the code number, each one was judged without knowledge of the age or ability of the art student producing it.

Since judgments concerning the amount of creativity shown in the paintings comprised the sole creativity criterion, it was vital for the investigators to obtain highly qualified critics. Art museum directors and heads of art education departments of three art museums concurred on three essential criteria for judges: (a) recognition as highly competent and experienced in the art education field, (b) complete familiarity with art work produced by children, both creative and less creative, and (c) interest and understanding of research methods.

Three judges meeting these criteria eventually were selected. They were given no orientation or instructions for judging other than that described below; however, they did discuss criteria informally.

Judges used an 11-point scale which was transformed later to a 16-point scale. (A computer program was available for a 16-point scale, as this scale is frequently used in attitude scaling.) Each judged the entire collection of paintings for creativity, giving every painting a score from 1 to 11 as to the amount of creativity expressed. The identical procedure was repeated, with each painting receiving a score from 1 to 11 as to the amount of technical competence expressed. One critic judged competence first, the other two judged creativity first. No communication between critics concerning the judgments was allowed during the entire judging. The judging procedure took place over four days with the critics giving thoughtful consideration to each judgment. Statistical analysis, which is reported later, showed very high agreement among the critics.

The four children with the highest and the four with the lowest combined creativity scores in each age group were selected for study of behavior variables assumed to be related to creativity.

Five general areas of questioning were selected. Reasons for selection were relevance to creativity, clarity of definition, and probability that those interviewed could be expected to give useful responses.

The interviewer made a judgment from the respondent's remarks concerning these general areas of questioning on a 1- to 5-point scale. One area, use

of free time, was not amenable to such evaluation. The areas explored were (a) conformity, (b) universality of creativity in areas outside of art, (c) use of free time, (d) emotional stability, and (e) motivation or determiners of behavior.

Questions were varied to fit the child's age. Also, they took slightly different forms to relate to behavior with which the parent, the teacher, the art instructor, or child would be familiar. All interviews were conducted by the first author. Five children in the 3 to 5 age group were too young for public school, but four attended nursery school and the nursery school teacher was interviewed. For the remaining child, the Sunday School teacher was interviewed.

During the entire time of interviewing, the judges' scores on the children were deliberately withheld from the interviewer for maximum objectivity. Also, the students, their parents, school teachers, and art instructors had no knowledge of which were the high and which were the low creative students.

Statistical analysis of the differences between the means of the high and low creative groups was by *t*-tests.

C. FINDINGS AND DISCUSSION

The statistical data are displayed in the following tables.

Table 1 shows the progression of the means of creativity and technical competence by age. Table 2 is a summary of the analysis of variance results of the data. For the purposes of Table 2, the term "traits" is used to represent the two dimensions, creativity and technical competence. It was not intended to imply that creativity and competence are traits in the usual psychological sense.

TABLE 1
JUDGMENTS OF PAINTINGS IN MEANS ON 11-POINT SCALE

Judgment	3-5	6-8	Ages 9-11	12-14	15-18	Total mean
Creativity	5.41	6.12	5.80	4.62	6.74	5.74
Technical Competence	3.03	4.40	5.33	5.22	7.60	5.12

Table 3 is a summary of comparisons on four characteristics in high-creative and low-creative students. The characteristics examined are conformity, universality of creative behavior, emotional stability, and self-motivation.

1. Hypothesis 1

The first hypothesis, that creativity and competence could be separated, was supported. The correlation coefficient between the creativity and technical

TABLE 2
SUMMARY OF THE ANALYSIS OF VARIANCE ON JUDGMENTS OF PAINTINGS

Source of variance	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	Variance component
A	1389.9	4	347.47	54.46	.01	1.89
S/A	2919.1	70	41.70	6.54	.01	2.94
P/S	478.5	75	6.38	2.86	.01	.69
T × A	505.1	4	126.27	31.41	.01	1.36
T × S/A	3208.9	70	45.84	11.40	.01	6.97
T × P/S	301.2	75	4.02	1.80	.01	.60
J × A	46.6	8	5.83	2.28	.05	.05
J × S/A	472.8	140	3.38	1.32	.05	.20
J × P/S	384.2	150	2.56	1.15	n.s.	n.s.
J	38.7	2	19.36	8.68	.01	.05
T	85.2	1	85.25	38.23	.01	.18
J × T	3.3	2	1.64	n.s.		n.s.
J × T × A	28.5	8	3.56	n.s.		n.s.
J × T × S/A	376.7	140	2.69	n.s.		n.s.
J × T × P/S	334.5	150	2.23			2.23

Note: A = Age, S = Subjects, T = Traits, J = Judges, and P = Paintings.

competence scores was $+.062$. Further statistical evidence that this hypothesis can be accepted was shown by the analysis of variance results in Table 2. The pertinent variance component was the interaction of traits and subjects within age. This was the largest variance component of all, 6.97.

2. Hypothesis 2

Hypothesis 2 concerned the progression of creativity and competence with age. Table 1 is pertinent to this hypothesis. Also in support of Hypothesis 2 is the size of the variance component for the traits \times age interaction (.89 in the analysis of variance table, significant at the .01 level). Clearly, creativity and competence did not have the same developmental patterns.

Hypothesis 2 as stated could not be accepted because of the rise in creativity shown by the highest age group. Examination of the raw data reveals that the increase in creativity at the highest age group was largely concentrated at ages 16 and 17.

The judges showed a high degree of agreement, a fact substantiated by the low variance component for judges of .05, and by the three interjudge reliability coefficients of .81, .80, and .76. Judges also gave similar scores to the two paintings of each student, the interpicture reliability being .72. The variance component, for paintings within subjects, was relatively small. This indicates the substantially similar results on each subject's two paintings.

Developmental curves of creativity and competence showed that creativity remained relatively constant to about 15 years of age with a sharp rise for

TABLE 3
FOUR PERSONALITY CHARACTERISTICS IN HIGH AND LOW CREATIVE ART STUDENTS: MEANS ON A FIVE-POINT SCALE

	Overall mean	p*	By age group					By person interviewed		
			3-5	6-8	9-11	12-14	15-18	Child	Mother	Teacher instructor
Conformity										
High creative	1.8		1.7	1.6	2.4	2.1	1.4	1.7	1.7	1.9
Low creative	3.0		2.6	2.8	3.6	3.4	2.6	3.0	3.1	2.9
	1.2	.05								
Universality of creativity										
High creative	3.3		3.4	3.0	3.4	3.6	3.0	3.4	3.7	2.8
Low creative	2.3		2.1	2.1	2.3	2.1	2.8	2.6	2.3	2.0
	1.0	.075								
Emotional stability										
High creative	3.0		3.1	3.1	2.4	3.2	3.1	2.9	2.9	3.0
Low creative	2.5		2.3	2.6	2.6	2.2	2.6	2.2	2.4	2.4
	.5	.15								
Self-motivation										
High creative	3.3		2.8	3.5	3.4	2.9	3.8	3.2	3.2	3.4
Low creative	2.6		2.6	2.4	2.4	2.6	2.8	2.7	2.3	2.7
	.7	.10								

* The probability of the observed difference in means under the hypothesis of all observations coming from the same population, as calculated by a two-tailed *t*-test.

the age group 15 to 18, whereas technical competence advanced gradually and steadily with age. One would expect competence to increase with age. The ability to express creativity, on the contrary, does not seem as related to experience.

The reason for the sharp rise in the high school group may be due to the sample; perhaps children of these ages do not attend the art classes unless highly involved in art. Selection factors may be greatest at this age; the time of most numerous interests comes prior to adolescence. Children from 14 to 18 years have narrowed their interests.

Creativity was at a plateau from 3 to 11 years, dropping off slightly up to 14 years and then advancing more steeply to 18. This drop in creativity in middle childhood has been found by other researchers (1).

The developmental pattern of creativity suggests that teachers do not need to wait for a child to gain competence in art before encouraging him in creative expression.

Care should be taken not to read too much into the developmental pattern, remembering that this is a cross-sectional, not a longitudinal, study. Some part of the variation by age may be due to sampling fluctuation. Only a longitudinal study could confirm these findings. Also, the number of subjects, 75, was not large.

3. Hypothesis 3

The acceptance of Hypothesis 1 makes meaningful the division of high and low creatives for the study of Hypothesis 3. A considerable range of competence appeared in both the high and low creative groups.

When the interviews of the most and least creative children were completed, as well as interviews of their parents, school teachers, and art instructors, these data were tabulated. Table 3 displays the results on four of the five variables studied. The fifth variable, use of free time, did not prove amenable to quantitative measurement. In Table 3, the mean response for the highs can be compared with the mean response for the lows in each age group and by each person interviewed. The results of the *t*-tests shown in Table 3 clearly indicate the statistical significance of the difference of means in the observed data.

a. Conformity. The interview data on amount of conformity, expressed in Table 3, clearly showed conformity as a variable that distinguished the high and low groups at all ages. Children in the high creative groups were consistently less conforming than those in the low creative groups at every age.

b. Universality. Table 3 shows that this variable separated the high and

low groups at all ages. Children in the high creative groups showed more creativity in areas outside of art than did those in the low creative groups.

c. Emotional stability. This area of investigation produced voluminous discussion, apparently being of great interest. Again, this was a behavior variable that separated the high and low creative groups, although, of the four variables tabulated, this one showed the least difference in the two groups. The high creative groups were rated more emotionally stable than were the low creative groups, in every age group except 9 to 11, as shown in Table 3.

d. Motivation. This variable was included to investigate self-motivation *versus* motivation from outside sources, such as working to please others. This variable also clearly separated the high and low creative students, with the high creative group showing more self-direction, inner or intrinsic motivation, and the low creative group emphasizing extrinsic motivation at all ages.

e. Use of free time. In the pilot study this variable created considerable interest. Though it did not prove amenable to the five-point measurement, it was included in the investigation in an effort to explore its value for future use. High creative art students did appear to use their free time in a different fashion from low creative art students, suggesting that there was a relationship between creativity and how a child used his free time. The high creative children spent more time alone reading, working, playing, and daydreaming; they belonged to fewer organized groups and became more engrossed in free time activities, therefore spending more free time at one activity, such as art or drama. These findings were true at all ages.

In summary, Hypothesis 3, which read "most and least creative art students differ at all ages on behavior related to (a) conformity, (b) universality of creativity, (c) use of free time, (d) emotional stability, and (e) kind of motivation," was supported by the interview data and therefore accepted.

D. SUMMARY

Creativity and technical competence in art were studied in 75 children aged 3 to 18 years. Subjects' paintings were evaluated by experts and individual assessments were made of children's personal characteristics. It was found that (a) creativity and technical competence in children's artistic productions could be separated judgmentally; (b) these two dimensions showed different developmental patterns with technical competence increasing gradually and steadily with age, and creativity remaining relatively constant from 3 to 15 years with a sharp rise from 15 to 18 years; and (c) behavior differed in the students judged most and least creative in all of the age groups.

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REINFORCEMENT SCHEDULES AND RESPONSE VARIABILITY IN FIRST GRADE CHILDREN*¹

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A. INTRODUCTION

The authors have previously reported concerning reinforcement schedules and response variability in preschool children (1). The study was concerned with the effects of prior experiences of fixed-ratio (FR), variable-ratio (VR), or regular-reinforcement (R) schedules on the subsequent response variability of preschool children. It was found, in general, that preschool children preconditioned on a variable reinforcement schedule were subsequently the most variable in their responses. With the exception of use of first grade children in place of preschool Ss, the present study was concerned with the same general area of research.

B. METHOD

1. *Apparatus*

The apparatus for preconditioning the Ss has been described in detail elsewhere (1). Essentially, it consisted of a "slot machine" placed at the end of a straight runway 15 feet long and four feet wide. The machine was modified to deliver a marble on predetermined schedules. A small chair was placed at the "start" end in front of an enclosed chamber housing a pulley-weight system. A leather child harness was attached to the pulley-weight system by means of a light wire that passed through a small hole in the chamber and snapped into a metal ring at the back of the harness. Concealed photo-electric cells at the "start" and "goal" ends of the runway stopped electric timers when S broke the beams. The apparatus used to quantify response variability has also been described in detail elsewhere (1). It consisted of a standard Foringer Marble Dispenser encased in a plywood frame in such a manner as to conceal the marble hopper and present to S only the plastic "payoff"

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² Deceased.

dish. On the back wall of the plywood frame, concealed from the view of *S* by a black curtain, were four devices: a lever, a doorbell button, a chain, and a drawer knob. These manipulanda were fixed to individual movable fiberboard panels. Pilot lights on the back of each panel enabled *E* to record the device manipulated by *S*.

2. Subjects

Twenty first grade children, 10 males and 10 females, were recruited from the community and assigned randomly into four groups, three experimental and one control.

3. Procedure

The same procedure was followed as described in the previous study with preschool *Ss* (1). All the experimental *Ss* were experienced on the straight runway prior to exposure to the variability apparatus. One experimental group was placed on FR, one on VR, and one on R reinforcement schedules. The control *Ss* were exposed directly to the variability apparatus. Each child in the *E* groups received a total of 60 trials on the straight runway. Of the 60 trials, the first 30 were presented on R schedule. The R group continued on this schedule for the remaining 30 trials, the FR group on one reinforcement for every fourth response (FR-4), and the VR group on one reinforcement, on the average, for every fourth response (VR-4).

In the preconditioning phase, the *S* was seated in the chair at the "start" end of the runway and instructed to go to the "goal" end of the runway when the white pilot light went on at the end of the runway. The pulley-weight system was fitted with a one-pound weight and snapped to the leather harness. The *S* was instructed to pull the lever on the "slot machine" and, if anything came out, to put it in the metal box at the side of the runway, return to the chair, watch for the light, and "play the game" again. If nothing was received, he was to touch the "payoff" tray, return to the chair, wait for the light, and "play the game" again. Reaction time and running time were recorded.

In the variability phase, the *E* groups, following runway experiences, and the C group without this experience were exposed to the variability apparatus for 60 reinforced trials on R schedule. On this apparatus the *Ss* were told to put their hand under the curtain and see whether they could "make the box work." If they obtained anything, they were to put it in the metal box at the opposite end of the room, return, and "work the box" again. All manipulative devices were set to "pay off" a marble. The positions of the devices were "scrambled" by one *E* concealed behind the apparatus, while *S* was placing the marble in the metal box at the opposite end of the room. This *E* also

recorded the devices used by *S* to obtain the marble. The children were given trials in blocks of five on each of four arrangements of the manipulanda.

At the termination of the study each *S* was given a choice of a "take-home marble."

C. RESULTS

There were no significant differences between experimentals and controls in reaction times nor in running times on the straight runway.

Figure 1 shows the responses made on the variability apparatus by the four groups of first graders. Among the controls, it can be seen that two of the *Ss* were device-stereotyped and used one device in all four positions to obtain

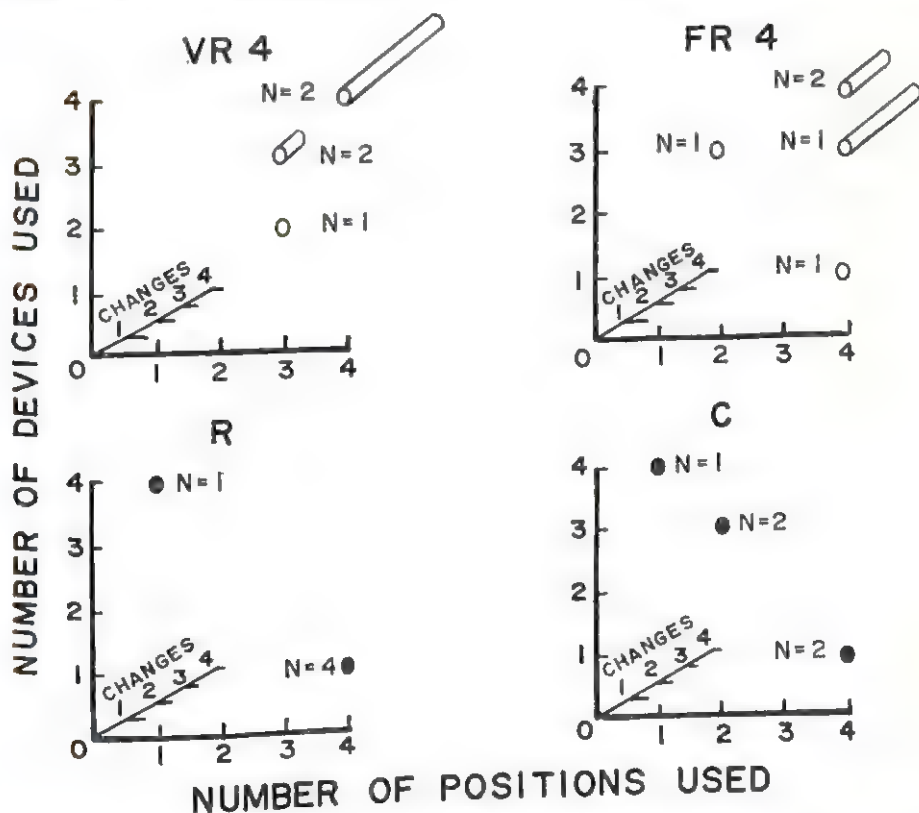


FIGURE 1

REINFORCEMENT SCHEDULES AND RESPONSE VARIABILITY IN FIRST GRADE CHILDREN

Reinforcement schedules and response variability in first grade children are shown graphically on three axes: (a) on the ordinate the number of devices used throughout all trials; (b) along the abscissa the number of positions used throughout all trials; and (c) along the third dimension the numbers of changes made from one device to another within trial blocks are depicted by the length of the cylinders.

the marble reward. One *S* was position-stereotyped and used whichever device happened to occupy the preferred position to obtain the marble reward. Two children used more than one device and more than one position to obtain reinforcement. It was noted that device changes, although occurring between arrangements of manipulanda, never occurred *within* blocks of trials on any particular arrangement of the devices.

Figure 1 shows that three of the FR-4 group used more than one device and more than one position to obtain the marble, and that manipulanda changes did occur *within* blocks of trials, as well as between particular arrangements. In the case of two of these *Ss*, device changes occurred 30 per cent of the time during blocks of five trials on the four arrangements of the manipulanda. In the case of one child, device changes occurred on the average of 55 per cent of the time during the five trials on the four arrangements of the devices. As Figure 1 shows, one child in the FR-4 group used two positions and three devices to obtain the marble reward; none of the device changes occurred *within* particular arrangements of the manipulanda, but only between arrangements. It is evident that one of the *Ss* in this group was device-stereotyped and used the same device to obtain the marble irrespective of its position in the arrangements of manipulanda.

Among group R children, Figure 1 shows that four *Ss* were device-stereotyped and one *S* position-stereotyped.

It is noted from Figure 1 that among the VR-4 group of children, four *Ss* not only used more than one device and more than one position of devices to obtain the marble, but switched manipulanda *within* blocks of trials on different device arrangements. Two children in this group changed devices on the average of 87 per cent of the time during blocks of five trials on the four device arrangements. Two of these *Ss* changed devices on the average of 12 per cent of the time during blocks of five trials on the four arrangements of manipulanda. As Figure 1 shows, one of the children in this group, although using two devices and three positions to obtain the marble, never changed manipulanda *within* particular arrangements of devices.

D. DISCUSSION

Screven,⁸ using a straight runway situation similar to the one used in the present study, reported that "running time with first grade subjects does not appear to distinguish between different incentive levels at low work loads,

⁸ Reported by C. G. Screven in the seminar on experimental methods at the annual meeting of the American Psychological Association, 1958.

but only at high work loads." Using one pound loads, the authors previously reported (1) that this statement was apparently not valid for preschool children, since significantly faster running times were found for Ss experiencing FR-4 reinforcement than for those on VR-4 and R schedules. In the present study with first grade children, Screven's statement is confirmed.

McCray and Harper (2) found that kindergarten children preconditioned under a VR-4 reinforcement schedule subsequently showed greater response variability than did controls or children preconditioned under FR-4 or R schedules. In general, with some exceptions, the authors found this to be true when the Ss were preschool children (1). It is of interest to compare the results of the present study, which involved first graders, with those of McCray and Harper (2) utilizing kindergarten children, and those of Benson *et al.* (1) involving preschool children. The former authors reported that all their controls were device-stereotyped on the variability apparatus; the latter investigators found that 50 per cent of their preschool control Ss were device-stereotyped. In the present study, 40 per cent of the control first graders were device-stereotyped on the variability apparatus. It has been reported (1) that 37 per cent of preschool children controls did manifest some variability, since they used more than one device and more than one position to obtain the marble reward. However, the "scope" of this expression of variability was reduced by the fact that device changes never occurred *within*, but always between, particular arrangements of the manipulanda. In the present study, 60 per cent of the control Ss used more than one device and more than one position to obtain the marble reward. In the case of the preschool Ss, this manifestation of variability was limited to device changes between, rather than *within*, arrangements of the manipulanda. This may be an indication of a trend toward increased variability as a function of age and school experiences.

In the present study, first graders, preconditioned on a regular reinforcement schedule, were all either device- or position-stereotyped on the variability apparatus. The same characteristic was reported for kindergarten Ss preconditioned on regular reinforcement schedules (2) and for preschool children (1).

It has been reported that kindergarten and preschool children (1, 2) preconditioned under FR-4 schedules failed to manifest marked response variability subsequently. However, results of the present study have shown that 60 per cent of the children preconditioned on FR-4 schedule subsequently exhibited considerable response variability, since they not only used different devices and positions to obtain the marble reinforcement, but actually changed devices a high percentage of the time *within* the blocks of five trials on

particular arrangements of the manipulanda. Comparatively this appears to be a significant finding, warranting extension of the study to children beyond the first grade level.

McCray and Harper (2) and Benson *et al.* (1) found that with kindergarten and preschool children, respectively, those preconditioned on a VR-4 schedule were subsequently more variable in their responses than any of the other groups studied. The results of the present study, particularly in terms of the number of device changes within blocks of five trials on the four arrangements of manipulanda, agree well with the above findings.

E. SUMMARY

Twenty first grade children were divided into four groups of five Ss each for the purpose of studying effects on subsequent response variability of the prior experiences of fixed-ratio, variable-ratio, and regular-reinforcement schedules.

Similarities and differences between responses of first graders used in the study and responses of kindergarten and preschool children used in previous similarly designed studies were discussed.

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RORSCHACH RESPONSES OF NEGRO AND WHITE 5- TO 10-YEAR-OLDS*

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A. INTRODUCTION

The present study reports on Rorschach responses of Negro public school children aged 5 to 10 years. It aims to do two things. First, it compares these responses with those of same-age children of other socioeconomic and intellectual levels. Second, it attempts to determine what happens to the Rorschach response of the Negro child as he grows older.

B. METHOD

Subjects are 217 Negro elementary school children, both boys and girls. The Rorschach was administered individually to each of these children, during school hours and in a special examining room in the school building. Records are available on thirty 5-year-olds, nineteen 5½-year-olds, fifty 6-year-olds, forty 7-year-olds, twenty-five 8-year-olds, thirty-three 9-year-olds, and twenty 10-year-olds. Protocols were compared with those of three groups of white same-age children, examined earlier as part of ongoing Gesell Institute research.

Table 1 gives comparative *IQ* and socioeconomic level for the four groups

TABLE 1
INTELLIGENCE AND SOCIOECONOMIC STATUS (SES) OF SUBJECTS

Variable	New Haven	Weston	North Haven	Abraham Lincoln
Mean <i>IQ</i>	118	109.7	105.4	93*
Mean SES	Class II	Class II	Class III	Class VI**

* 10-year-olds only examined.

** 80 per cent of these children have known fathers.

compared in the present study. As the table shows, New Haven subjects were primarily of a superior intelligence and of a high socioeconomic status (SES). Parents of Weston subjects were of semiprofessional status and the subjects themselves of above average intelligence. North Haven subjects were of "clerical, skilled, or retail business" status and of average intelligence. Negro

* Received in the Editorial Office, Provincetown, Massachusetts, on November 12, 1965. Copyright, 1966, by The Journal Press.

children, from the Abraham Lincoln school in New Haven, were of "slightly skilled" SES and had a mean *IQ* of 93.

Socioeconomic status was measured on the Minnesota Scale of Paternal Occupations. Intelligence was measured on the Wechsler Intelligence Scale for Children (10), except for Abraham Lincoln children who were tested on the Slosson Individual Intelligence Test (9). All intelligence tests were given individually rather than as group tests.

The majority of Rorschach tests on subjects in all groups were administered by the chief investigator. Details of all earlier studies—on New Haven, Weston, and North Haven subjects—were given in earlier publications (1, 2, 3, 6, 7).

All Rorschachs given to Abraham Lincoln subjects were given by the writers, as were Slosson intelligence tests on Abraham Lincoln 10-year-olds, the only age group tested because of the fact that group tests could not be given and individual tests were too time consuming to test all subjects.

Rorschach protocols were scored by the Gesell scoring system, which follows closely the European method of scoring (2).

C. LITERATURE

Literature comparing white and Negro intelligence is plentiful (8), and for the most part agrees that mean *IQ* of Negro school children is lower than that of supposedly matched white groups.

However, the writers find only one, very recent, comparison of the Rorschach responses of Negroes and whites (4). This study reports on Rorschach responses of 65 of a total group of 85 Negro seventh grade students taking part in an improvement project, entitled the Bridge Project, in New York City in 1961.

Results were compared by the authors of the project with the normative findings of 13-year-olds (1). Results of this comparison are given in Table 2. As the table shows, Negro subjects were less productive, less constricted, less accurate, more banal than white subjects of the same age but of considerably higher intelligence, since Negro subjects had a mean *IQ* of 89 on the full scale WISC and New Haven subjects a mean *IQ* of 116.

As the table further shows, Negro subjects gave fewer responses, fewer human responses but more animal responses, and an equal number of color responses. Area was about the same for the two groups, except that New Haven subjects gave more Dd responses. A per cent and H per cent were higher in the New Haven subjects than in the Bridge Project subjects.

TABLE 2
 RORSCHACH SCORES FOR NEW YORK BRIDGE PROJECT SUBJECTS AND
 NEW HAVEN SEVENTH GRADERS COMPARED

Rorschach variable	Bridge Project subjects	Ames New Haven subjects
R	14.1	20.1
F%	53	63
F+%	82	93
P	3.6	1.5
M	1.1	2.1
FM	2.4	1.0
sC	1.1	1.0
W%	47.5	46.2
D%	46.6	45.9
Dd%	6.0	9.7
H	1.8	3.7
A	6.8	10.0

D. RESULTS

1. *Mean Scores*

Table 3 gives mean scores for all Rorschach variables for Negro Abraham Lincoln students as compared with means for earlier white students.

As this table shows, with a few exceptions Abraham Lincoln scores are poorer and in most instances substantially poorer than those of subjects of the other three groups for nearly every scoring variable at nearly every age.

The only consistent or conspicuous exceptions have to do with P per cent and F+ per cent. At only two of the seven ages in question do Abraham Lincoln students have a higher mean P per cent than do subjects of other groups.

More conspicuous is the fact that at four of the seven ages in question (that is, from 7 years through 10 years of age) Abraham Lincoln subjects have, if not the highest, at least not the lowest F+ per cent. The meaning of this finding will be discussed below.

Since both New Haven and Weston subjects are on the average of a much higher intellectual and socioeconomic status than are Abraham Lincoln subjects, the superiority of their Rorschach scoring is not surprising. Of the three groups of white children studied, only the North Haven subjects might be expected to be somewhat similar to the Abraham Lincoln children. Even here the *IQ* of 105 is considerably higher than the 93 mean *IQ* of Abraham Lincoln students.

TABLE 3
MEAN SCORES—FOUR GROUPS COMPARED

Rorschach variable	Group	5 yrs.	5½ yrs.	6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.
N	New Haven	13.9	13.6	15.8	18.3	16.0	18.6	16.3
	Weston	10.7	11.3	12.8	13.7	14.0	12.9	14.8
	No. Haven	10.8	10.0	13.1	11.0	12.8	11.9	13.5
	Ab. Linc.	11.0	10.0	8.0	9.4	8.8	10.0	10.0
F%	New Haven	70	62	60	52	58	67	63
	Weston	75	73	65	67	69	74	72
	No. Haven	80.5	73.5	73	73	67.5	70	71.5
	Ab. Linc.	84	91	86	79	81	76	78
F+%	New Haven	78	84	81	82	87	84	89
	Weston	78	83	87	89	89	92	92
	No. Haven	75	86	86	92	87	92	94
	Ab. Linc.	57	63	78	86	87	90	91
W%	New Haven	58	55	51	51	55	42	52
	Weston	66	73	63	61	60	64	63
	No. Haven	66	68	70	67	58	62	58
	Ab. Linc.	74	75	71	75	71	67	78
D%	New Haven	34	33	34	41	37	48	40
	Weston	30	25	31	32	35	31	31
	No. Haven	30	29	25	28	37	33	36
	Ab. Linc.	25	25	25	25	26	30	21
M	New Haven	.56	.44	1.0	1.4	1.3	1.4	1.7
	Weston	.66	.63	1.0	1.0	1.0	1.1	1.0
	No. Haven	.32	.60	.4	.7	1.1	1.4	1.9
	Ab. Linc.	.70	.26	.4	.5	.4	.6	.7
FM	New Haven	1.08	1.26	1.62	1.88	1.54	1.62	1.74
	Weston	1.00	.98	1.73	1.69	1.77	.86	1.80
	No. Haven	.56	.63	1.04	.99	1.77	1.27	1.73
	Ab. Linc.	.40	.11	.40	.50	.60	1.00	.70
sC	New Haven	1.63	2.26	2.16	2.89	1.80	2.09	1.51
	Weston	.44	.66	.94	.92	.64	.77	.45
	No. Haven	.78	.99	.98	.78	.87	.86	.55
	Ab. Linc.	.45	.47	.24	.07	.60	.40	.30
A%	New Haven	44	41	48	42	45	48	49
	Weston	59	52	54	55	57	63	67
	No. Haven	47	53	52	57	53	55	56
	Ab. Linc.	45	58	61	60	71	65	69
H%	New Haven	9	11	11	14	17	16	16
	Weston	13	12	14	15	17	16	16
	No. Haven	18	14	16	15	17	20	20
	Ab. Linc.	22	13	11	10	5	7	12
No. of content categories	New Haven	4.7	4.9	4.8	5.2	4.7	5.2	4.8
	Weston	3.8	3.7	3.9	4.2	4.4	3.8	3.5
	No. Haven	4.1	3.7	2.1	3.4	4.5	3.8	4.2
	Ab. Linc.	3.0	3.6	3.0	3.2	2.6	3.5	3.0

TABLE 3 (continued)

Rorschach variable	Group	5 yrs.	5½ yrs.	6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.
P%	New Haven	22	25	23	27	24	22	25
	No. Haven	23	31	33	38	36	38	40
	Ab. Linc.	22	26	31	33	37	40	40
Refusal	New Haven	.6	.7	.5	.3	.5	.5	.6
	No. Haven	1.2	1.1	.6	1.0	.4	.6	.5
	Ab. Linc.	1.2	1.6	1.4	1.5	2.1	1.4	1.5

Note: Mean scores of shading and inanimate movement have been omitted, since neither exceed .2 at any age.

Since earlier figures (7) indicate a clear correlation between excellence of Rorschach response and socioeconomic and intellectual status—with children of higher *IQ* and SES giving on the average more responses, lower F per cent, higher F+ per cent, more M, higher sC, and more content categories—it is not surprising that Abraham Lincoln students do give a poorer response than do subjects in other groups.

The outstanding exception to this rule is that mean F+ per cent for Abraham Lincoln subjects, in the age range 7 to 10 years, equals or exceeds that of other groups. It must be noted, however, that the Abraham Lincoln child maintains a high F+ per cent in the same way as does the deteriorating elderly subject (3), by reducing his number of responses and giving more refusals, by giving a higher F per cent, a higher W per cent, higher A per cent, and a higher percentage of banalities (P per cent). That is, he maintains correct form by refusing cards that are difficult for him and by giving simple, unenlivened, and banal responses to those to which he does respond.

2. Percentile Scores

Table 4 gives percentile scores for major scoring variables for New Haven, North Haven, and Abraham Lincoln Rorschachs at 5 years and at 10 years. As in the case of mean scores, this table shows that for most scoring variables, Abraham Lincoln scores were poorer, and in most instances substantially poorer, than those of the other two groups—though as would be expected Abraham Lincoln scores are much closer to those of North Haven than to those of New Haven subjects.

Thus as to number of responses, the 5-year-old Abraham Lincoln 75th percentile is equal only to the New Haven 25th percentile, but nearly equals the North Haven 75th percentile. But at 10 years the Abraham Lincoln 75th percentile for R equals only the 25th percentiles for New Haven and North Haven subjects.

TABLE 4
PERCENTILE SCORES, THREE GROUPS COMPARED

Rorschach variable	Percentile	5 years			10 years		
		New Haven	North Haven	Abraham Lincoln	New Haven	North Haven	Abraham Lincoln
R	75	17	11	11.5	21	20	11
	50	13	10	10.0	15	14	10
	25	11	9.5	7.5	11	11	8
W%	75	75	85	95.5	66	81	100
	50	58	71	70	55	55	93
	25	43	48	54	41	33	83
D%	75	48	40	44.5	54	65	42
	50	36	25	30	39	46	18
	25	25	10	0	28	29	0
Dd%	75	12	0	0	14	25	0
	50	8	0	0	4	9	0
	25	0	0	0	0	0	0
F%	75	80	98.5	100	76	86	100
	50	72	87.0	91	61	73	78
	25	65	71.5	81	52	57	63
F+%	75	90	87	78.5	100	100	100
	50	80	75	60	92	100	93
	25	70	61.5	40	84	90	83
M	75	1	1	1	3	2	1
	50	0	0	0	1	1	.5
	25	0	0	0	0	0	0
FM	75	2	.5	1	3	3	2
	50	1	0	0	1.5	1	.5
	25	0	0	0	0	0	0
sC	75	3.0	1	0	3	1	1
	50	1.5	0	0	1	0	0
	25	.5	0	0	0	0	0
A%	75	58	56	61	60	70	80
	50	40	43	45	45	57	69
	25	32	27.5	29	39	48	55
H%	75	16	37	33	21	26	20
	50	9	17	11	13	16	11
	25	0	10	0	7	10	0
No. of content categories	75	0	5	4	—	5	4
	50	—	4	3	—	4	3
	25	—	3	2	—	3	2

Outstanding instances in which Abraham Lincoln scores are poorer than those of both other groups are at 5 years: larger W per cent, higher F per cent, lower F+ per cent, lower sC; at 10 years: higher W per cent, higher F per cent, lower M, higher A per cent.

3. *Age Changes in Abraham Lincoln Responses*

In addition to comparing Abraham Lincoln responses with those of children from other racial and socioeconomic groups, it is of interest to observe what happens to the Abraham Lincoln response itself between the ages of 5 and 10 years, and to determine whether the Abraham Lincoln child's response most closely resembles that of North Haven subjects (the white group most like it in *IQ* and *SES*) at early or later ages: that is, at 5 or at 10 years.

Table 4 which gives mean and median scores for New Haven, North Haven, and Abraham Lincoln subjects at 5 and 10 years, and Table 3 which gives mean scores for all groups at all ages, show the following age changes in mean Abraham Lincoln scores:

R dips slightly from 6 to 8 years and then at 9 to 10 years returns almost to the 5-year-old level.

F per cent decreases slightly and irregularly.

W per cent increases slightly.

M decreases slightly and then returns at 10 years to the 5-year-old level.

FM increases very slightly.

sC remains about even, never reaching the level of a mean of 1sC.

A per cent increases conspicuously.

Number of content categories remains close to a mean of 3.

P per cent increases sharply.

Refusals remain at a mean of close to 1, except for a rise to 2 at 8 years.

As both tables indicate, the only score that shows conspicuous improvement between 5 and 10 years is F+ per cent, which increases (mean score from 57 per cent at 5 years to 91 per cent at 10 years, median score from 60 per cent at 5 years to 93 per cent at 10 years).

Table 5 shows clearly how this improvement in F+ per cent is achieved. The method is that used by aging individuals who, in their presumed insecurity, give fewer responses, more whole responses, a higher per cent of animal responses, and more banal responses than do younger persons, and by doing so maintain a reasonably high F+ per cent (3).

The last column in Table 5 compares the difference in response for each of the three groups from 5 to 10 years. As will be seen, whereas New Haven and North Haven subjects from 5 to 10 years increase their number of responses, lower F per cent, give fewer W, fewer A, and more M responses, as well as a higher F+ per cent, Abraham Lincoln subjects give fewer responses, more W, more A, fewer M, though a definitely higher F+ per cent.

TABLE 5
MEAN AND MEDIAN SCORES COMPARED AT TWO AGES

Rorschach variable	Group	5 years		10 years		Change from 5 to 10	
		Mean	Median	Mean	Median	Mean	Median
R	New Haven	14	13	16	15	+2	+2
	No. Haven	11	10	14	14	+3	+4
	Ab. Linc.	11	10	10	10	-1	=*
F%	New Haven	70	72	63	61	-7	-11
	No. Haven	81	87	72	78	-9	-14
	Ab. Linc.	84	91	78	78	-6	-13
F+%	New Haven	78	80	89	92	+11	+12
	No. Haven	75	75	94	100	+19	+25
	Ab. Linc.	57	60	91	93	+44	+33
W%	New Haven	58	58	52	53	-6	-5
	No. Haven	66	71	58	55	-8	-16
	Ab. Linc.	74	70	78	93	+4	+23
M	New Haven	.6	0	1.7	1	+1.1	+1.0
	No. Haven	.3	0	1.9	1	+1.6	+1.0
	Ab. Linc.	.7	0	.7	.5	=*	.5
A%	New Haven	44	47	49	45	+5	-2
	No. Haven	47	43	56	57	+9	+14
	Ab. Linc.	45	45	69	69	+24	+24
No. of content categories							
	New Haven	4.7	—	4.8	—	+1	—
	No. Haven	4.1	4	4.2	4	+1	=*
	Ab. Linc.	3.0	3	3.0	3	=*	=*

* That is, no change from 5 to 10 years.

4. Abraham Lincoln and North Haven Subjects Compared at 5 and 10 Years

Earlier research, in which intelligence test scores of white and Negro subjects have been compared (5), suggests that response of young Negro children more clearly resembles that of white children of somewhat comparable SES than does that of older Negro subjects.

For the present comparison, the writers have chosen merely the North Haven subjects' scores, since these children most closely resemble Abraham Lincoln subjects on both *IQ* and *SES*.

As Tables 3, 4, and 5 all indicate, *except for F+ per cent* (which improves more than any other score and which is *more* alike for the two groups at 10 than at 5 years of age), for every other variable (except *P* per cent, *sC*, and number of content categories, for which differences are small and about the same at the two age levels) differences are greater, and in the direction of a less "good" response, at 10 than at 5 years. This holds for *R*, *F* per cent,

W per cent, D per cent, M, FM, A per cent, H per cent, and number of refusals.

That is, the 5-year-old Abraham Lincoln response is in most respects more like that of a comparable group of white children than is the response at 10 years of age.

A further, not particularly scientific but practical, comparison inquires as to how well the best of the Negro children in each school (rather than all of the children) compare with white means. A broader study that deals with Mosaic as well as Rorschach scores of Negro subjects¹ suggests that at least a third of the children in each grade in the Abraham Lincoln school show what the writers consider to be academic promise.

How good is the response of these children as compared with the response of the average white subject? Table 6 compares the mean scores for the 15

TABLE 6
AVERAGE OF THE BEST ABRAHAM LINCOLN 6- AND 7-YEAR-OLD RORSCHACHS
COMPARED WITH MEANS FOR ALL SUBJECTS, ALL GROUPS

Group	N	F%	F+%	W%	D%	Dd%	M	FM	sC	A%	No. of content cate- gories
<i>6-year-olds</i>											
New Haven	15.8	60	81	51	34	15	1.0	1.6	2.2	48	4.8
Weston	12.8	65	87	63	31	6	1.0	1.7	.9	54	3.9
No. Haven	13.1	73	86	70	25	5	.4	1.0	1.0	52	2.1
All Ab. Linc.	8.0	86	78	71	25	3	.4	.4	.2	11	3.0
Best Ab. Linc.	12.0	72	91	70	26	4	1.0	1.0	.4	13	4.0
<i>7-year-olds</i>											
New Haven	18.3	52	82	51	41	8	1.4	1.8	2.9	42	5.2
Weston	13.7	67	89	61	32	6.5	1.0	1.7	.9	55	4.2
No. Haven	11.0	73	92	67	28	5	.7	1.0	.8	57	3.4
All Ab. Linc.	9.4	79	86	75	25	1	.5	.5	.7	60	3.2
Best Ab. Linc.	11.0	61	96	75	24	1	1.4	1.5	.8	52	4.0

best out of all 50 Abraham Lincoln 6-year-olds—that is, the top 30 per cent of the class—and the 13 best 7-year-olds out of 40—again, approximately the top third of the class—with the mean scores of all Abraham Lincoln subjects, and the means for all subjects in the three groups of white children.

Though not a statistically useful comparison, it does show that the best of the Abraham Lincoln subjects come very close to the mean of North Haven subjects (the white group most nearly like them in *IQ* and *SES*). In fact, in

¹ L. B. Ames and F. L. Ilg, in preparation.

a few instances—as in F per cent, M and FM, refusals, A per cent and H per cent, number of content categories at 7 years, and F+ per cent, at both 6 and 7 years—the top third of Abraham Lincoln subjects gives a better Rorschach response than does the average North Haven student.

5. Sex Differences

Sex differences as in the white child are small but, contrary to the situation with the white child, Negro boys give a slightly better Rorschach response than do girls, giving evidence of being slightly more productive, less restricted, and less global.

E. DISCUSSION

Perhaps the most significant finding is that for most scoring variables Negro Abraham Lincoln children most closely resemble white public school children of somewhat similar *IQ* and SES at 5 years of age, and that the Negro response falls increasingly far behind that of the white child in the years that follow.

Does this result from the fact that present environmental conditions under which many Negro children live are more damaging to them in the years from 5 to 10 than in the first five years of life? Or is it that just as some entire races of people are, on the average, shorter physically than others, that Negro children may not be genetically endowed so as to develop as far as do white children in those specific dimensions measured by the Rorschach test? Present data supply no answer to these questions.

Though considerable effort is being put into special training of underprivileged *preschoolers* in this country, present findings suggest that probably more emphasis should be put on the years from 5 to 10 than on the preschool years.

Second, it should be particularly noted that, in the present subjects, Negro children maintain a high and adequate F+ per cent (correct form per cent) only by decreasing number, variety, and quality of their responses. This suggests that it would be useful if we could find a way to help Negro children maintain an adequate correct form of response without sacrificing originality.

Third, it should be noted that in addition to giving almost no shading or inanimate movement responses, Negro subjects of the present study are with a few exceptions lacking in the kinds of response that would give an indication of special individuality factors, and also in the kinds of response that show qualitative aspects of the different ages (2). This is not entirely surprising, since the same is true of North Haven subjects who are also of a more modest intellectual and socioeconomic standing.

It is probably safe to say that both qualitative personality and age indicators are usually lacking in the Rorschach responses of children with *IQs* much under 105.

Lastly, comparing the 13-year-old Negro "Bridge" subjects (4), with white children of the same age, and responses of Abraham Lincoln 5- to 10-year-old Negro subjects with white children of the same ages, the writers find some similarities but conspicuous differences in the two sets of data.

Both comparisons find fewer responses, lower *M*, less maturity, lower *H* per cent in Negro than in white children. However, for other variables, there is marked disagreement in the two sets of data. Present 5- to 10-year-old Negro subjects show greater restriction (higher *F* per cent, higher *A* per cent) and less emotional response than do white children of the same age, whereas for 13-year-old Bridge subjects compared with 13-year-old white children the differences are in the opposite direction. Also, present Negro subjects, at least from 8 to 10 years, give an *F*+ per cent that equals or exceeds that of some of the white subjects, while Negro Bridge subjects have a lower mean *F*+ per cent than do white subjects of the same age.

Though the present paper does not aim to present or to discuss individual Rorschach responses, the writers make an exception in the case of a 5-year-old girl, D.C., a member of the Abraham Lincoln kindergarten class. Table 7 gives her highly enlivened response in full.

Though some Rorschach workers will consider the high percentage of human and animal movement shown in this record to be excessive and indicative of anxiety and other personal problems, and though clearly this response is at a preschool level, it is the preschool response of a good bright child and shows what a highly enlivened record a well endowed child can produce regardless of race or social environment.

F. SUMMARY

The Rorschach responses of 217 Negro elementary school children aged 5 to 10 years were compared with responses of three groups of white elementary school children. For every Rorschach variable except *F*+ per cent, responses of Negro children were less "good" than those of white children. With only minor exceptions, Negro children showed themselves to be less productive, less creative, less emotionally responsive, and more restricted than white children of the same age.

Negro children appear to maintain a high level of accuracy, but at the expense of productivity and originality. The most suggestive finding was that responses of Negro children most closely resemble those of white children

TABLE 7
RESPONSE OF NEGRO KINDERGARTEN PUPIL GIRL, D.C., AGED FIVE YEARS
AND SEVEN MONTHS, ABRAHAM LINCOLN SCHOOL

WS	F+	(H)	P	I.	Dat looks like a ghost. (How tell?) My friend.
W	M	(H)	P	II.	A witch. (How many?) Two. (Tell about?) They're trying to go somewhere. (How know witch?) My Mommy told me.
DW	M	H	P	III.	A man and two girls. One girl and a man. (Tell about?) Day bringing the ducks. (Ducks are top red.)
W	M	H		IV.	Das bout dey was goin somewhere and the POLice catch them. (?) Man and lady dey going. (Asked to show man and lady, it is the man and lady in Card III.) Dis is de POLice (Card IV.)
W	FM	A		V.	Das dey a duck and pig. (?) My Mommy told me. (Tell about?) He go to the police and the police catch him and knock him down.
W	FM	A		VI.	Dese are cat. Cat he went to the store and buy some cat food and he ate it for breakfast. He came and got the new boy and carried him home.
W	M	H		VII.	Ah! Dese are two women and dey putting on dey clothes so dey can go out. Goin to a party. De police say he take them up. (Evidently merely going to take them there, not arrest them.)
DW	M	H	P	VIII.	Uh huh! Two squirrels. Dey went out and de police catch em. (Police is the pink and orange below the pink squirrels.) Dey take him out. Dey carry him home.
D	M	(H)		IX.	Uh huh! Dese two (orange) mens talking together. And dey talk and went to the store and buy some whisky. (?) Two ghosts (pink) and dey was fighting.
DW	FM	A		X.	Dis was birds (blue) and break into house and hit the men, all dese men.

at 5 years of age, and that the discrepancy between the two groups increases with added age.

Negro subjects, with a few exceptions, are lacking in the kinds of response that give an indication of special individuality factors, and also in the kinds of response that show qualitative aspects of the different ages.

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ACCELERATION OF CONSERVATION OF SUBSTANCE* 1, 2, 3

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A. INTRODUCTION

Experimental induction of the concept of conservation of substance was the primary concern of this experiment. Conservation of substance is attained when the child notes that the total amount of a substance remains constant even though shape or geometric form is altered. One method of testing for the presence of this concept is to present two clay balls of the same weight and diameter. After emphasizing the equality of substance, the experimenter deforms one of the balls into another shape (cross, sausage). The child is then asked whether the deformed object has less, more, or the same amount of clay as the ball. Liquid substances can be used by utilizing various shaped containers.

Piaget (9) and his colleagues have extensively investigated the concept because of their belief that important cognitive operations—namely, decentering and reversibility—are involved in the conservation task. Decentering, as seen in the conservation task, is the ability to account simultaneously for perceived change in two dimensions. The nonconserving child attends to change in only one dimension, such as length or width, and therefore asserts that the deformed object has either more or less clay than the original object. The conserving child realizes that change in one dimension (height) is compensated for by change in another dimension (width). Reversibility, in the conservation task, is the ability to see that the deformed object can be transformed back into its original shape. These operations enable the child to extend his interaction with his environment because he is no longer tied to direct physical

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¹ This investigation, the author's Doctoral dissertation, was part of a larger project concerned with the acceleration of intellectual development. The project, under the direction of Carl Bereiter of the University of Illinois, was supported by the Cooperative Research Program of the Office of Education, United States Department of Health, Education, and Welfare, Project 4-10-008.

² Based on a paper read at the Educational Research Association meeting in Chicago, Illinois, February, 1965.

³ Dr. Luther Pfleger, Principal of the Hawthorne Elementary School in Oak Park, Illinois, was extremely helpful in providing the setting for the data collection.

action in his representational thought, but is able to rely on mental reversibility of his actions.

In general, Piaget has not attempted to accelerate the acquisition of the concept but has studied its manifestations in both conserving and nonconserving children. Other investigators (2, 10, 11, 12, 13, 14, 15, 16) have tried to induce experimentally the concept of conservation of substance. Smedslund has tested hypotheses derived from both external reinforcement learning theory and equilibrium conflict explanations of cognitive development. It is generally agreed that Piaget has said relatively little about these rules of transition (4, 6, 7), one exception being his treatment of accommodation, which is the change in intellectual structure necessitated by demands that the environment makes on an individual. Studies of attempts to accelerate conservation of substance have been reviewed in Brison's unpublished Doctoral dissertation (1), in Flavell's book (4), and by Wallach (17). These reviewers agree that previous attempts to induce conservation of substance experimentally have met with only modest and tenuous success, and this has impeded efforts to test hypotheses derived from various theories.

The present study was different from most other attempts to induce conservation, such as Smedslund's, in that acceleration itself was the primary purpose, and not the testing of hypotheses derived from opposing theories. This strategy seemed justified because of the previous resistance of the concept to experimental induction. If the acquisition of conservation can be accelerated under controlled experimental conditions in a relatively short period of time, then subsequent research can isolate and test theoretical explanations of the learning that occurred.

There are several possible reasons why previous attempts to induce conservation have not been successful. The children used in these experiments might not have understood the words *more*, *same*, and *less*, which are used in the conservation test. Furthermore, there is always the possibility that the child will not apply these words unambiguously to the conservation question. For instance, when asked whether a sausage (which has just been made from a ball) has more, same, or less clay, a child may apply the word *more* to the length and not the amount. An additional explanation is that the experimental conditions may not have been motivating, or that attention to the training was not adequately maintained.

In this experiment the children were pretested for the understanding of *more*, *same*, and *less*. An attempt was also made to get the children to apply these words unambiguously to the conservation situation by asking them whether the glass the liquid was poured into had more (same, less) juice to drink. It is then difficult to apply the terms to anything other than amount.

In regard to the problems of motivation and attention, the attainment of a larger reward was contingent upon acquisition of the concept of conservation. This aspect was introduced to produce a set to integrate the elements that are necessary to solve the conservation problem. In addition, a child's expectation was reversed, which appears to have motivational properties (3, 6).

This experiment was also designed so that properties of the experimentally induced concept could be studied: specifically, (a) transfer of conservation to materials not used in experimental training, (b) stability of the concept when the child was faced with an apparent contradiction, and (c) relevance of a set to seek explanations and search for causes for acquisition of conservation.

B. METHOD

The subjects were pretested on verbal concepts (more, same, less), conservation of substance, and explanatory set. Those who showed no evidence of conservation of substance were divided into a no-training control group ($N = 26$) and an experimental group ($N = 24$) that received training. The control and experimental groups were matched on their explanatory set scores. Twelve subjects who clearly demonstrated conservation of substance on the pretest participated in the experimental training. All subjects were posttested on conservation of substance, and those who gave acceptable conservation responses were administered an extinction item. The temporal order of events was as follows: first day—pretests; second and third days—experimental training (25 minutes per day); seventh day—posttests and extinction.

1. Subjects

The subjects were 62 kindergarten children from a middle-class suburban community. They ranged in age from 5 years, 4 months to 6 years, 4 months, with a mean of 5 years, 7 months.

2. Apparatus

Materials employed for the conservation of substance questions were clay in 3½-ounce balls, white sand, and a red fruit-flavored juice drink. The drink was also used in the experimental training sessions. Regular cylindrical drinking glasses served as containers. The extinction item required a glass with a thick bottom, but the other glasses did not have this type of bottom.

3. Procedure

a. Pretests of verbal concepts. The experimenter showed the subject two identical cylindrical containers with unequal amounts of juice and asked successively which glass had less juice to drink, more juice to drink, or did

they have the same amount of juice to drink. After equalizing the amounts, the S was asked if the containers had the same amount of juice to drink.

b. Conservation of substance pretests. The conservation of substance tests used the familiar format originated by Piaget and used by others. Additional conservation questions were given only if all four verbal pretest answers were correctly answered. The general format was as follows: The examiner presented equal amounts of substance and stressed the sameness of amount. Then one of the objects was made into another shape. The experimenter asked if the new object had more, the same, or less substance than the other object. The subject's reaction to this question was called the prediction. The subject was then asked to explain his prediction (explanation). Simple restatement of the prediction drew the response, "Why do you think they are the same (more, less)?"

The order of pretest conservation questions was as follows:

1. Two identical cylindrical glasses of juice—the juice of one glass was poured into a narrower glass (on all juice items, the experimenter asked if the new shaped glass had more, the same, or less juice to drink than the original glass). This item was administered by the experimenter immediately after the verbal pretests. This was a screening question done individually in a corner of the kindergarten class. The children were then given the rest of the conservation questions and the explanation questions by another examiner in another room.
2. Two orange balls—one changed into a ring.
3. Two green balls—one changed into a triangle.
4. Two identical cylindrical containers with equal amounts of sand—sand from one poured into wider glass.
5. Two identical cylindrical containers with equal amounts of sand—sand from one poured into narrow glass.

Conservation Questions 2, 3, 4, 5 were not administered by the same experimenter as was Question 1.

c. Conservation scoring categories. All explanations irrespective of the accuracy of the predictions were scored either acceptable (acc) or unacceptable (U). Acceptable explanations represented some attempt to organize the features of the situation into an explanation. Perceptual responses ("it looks bigger") were scored acceptable. An unacceptable explanation was one that did not represent an attempt to formulate an explanation. Common examples were insistence on restating the prediction and referral to an outside source (i.e., "my mother told me so").

Explanations to all correct predictions were scored as follows:

1. Adequate—two categories of adequate responses were scored (*a*) compensation (any reference to the fact that change in one dimension is compensated by change in another dimension) or (*b*) reversibility (referral to the original equality of the substance). The explanation that nothing had been added or taken away from the object before it was deformed was included in this category.

2. Inadequate—explanations that were obviously wrong.

Three hundred and fifteen explanations were scored as acceptable or unacceptable by two independent judges. The percentage of agreement was 96 and a phi correlation coefficient of .84 was obtained. In 108 explanations to correct predictions scored as adequate (compensation or reversibility) or inadequate, the judges agreed on 94 per cent of the ratings.

d. Explanatory set. The explanatory questions were included in the pretesting in order to see if the general tendency to look for causes and formulate explanations had any relevance to the experimental induction of conservation in nonconserving children. The experimenter administered the explanation questions upon finishing the conservation pretesting. The questions were as follows:

1. Why do houses have doors?
2. Why do books have covers?
3. Why can older boys (girls) usually run faster than you can?
4. Why do people read?
5. Why is it harder to ride a bicycle than a tricycle?
6. Why don't people spank little tiny babies?

The subject's explanatory set score was the total points he received on the explanation questions plus one point for each *acceptable* explanation on conservation questions.

e. Criteria for inclusion in experimental and control groups. The subjects had to pass all four verbal concept questions and fail the first conservation of substance (juice) question by giving a wrong prediction. On the four additional conservation questions the subjects did not give any correct predictions with adequate explanations and not more than two correct predictions with inadequate explanations. Each group (experimental and control) gave a total of only four correct predictions with inadequate explanations. The subjects were matched on their explanatory set scores and randomly assigned to both groups.

f. Criteria for selection of the conservation group. Ten of the 12 subjects in the conservation group gave at least four correct predictions with adequate explanations in response to the pretest conservation questions. One subject

predicted correctly four times with three adequate explanations. The remaining child had two correct predictions with adequate explanations.

g. Experimental training: first day. The experimental groups were divided into six subgroups and two conserving subjects assigned to each subgroup. The subjects in each subgroup were shown two identical cylindrical glasses A and B (see Figure 1) with obviously unequal amounts of juice. Figure 1

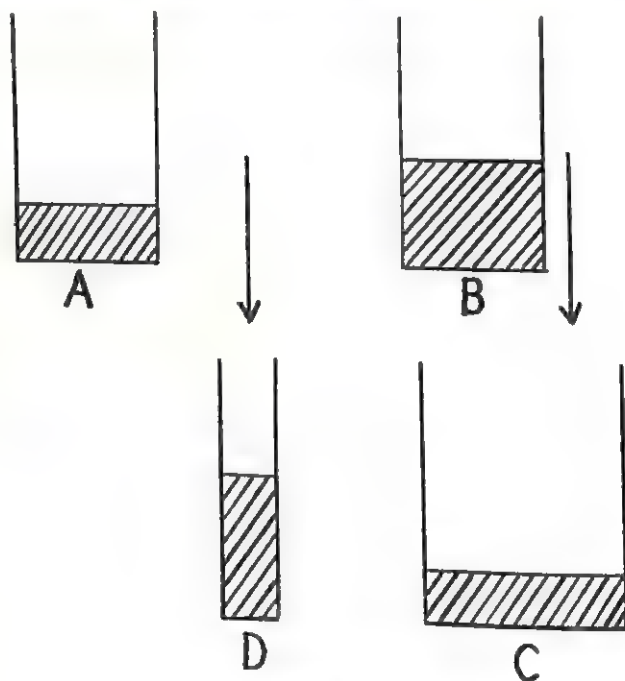


FIGURE 1
GLASSES USED IN EXPERIMENTAL TRAINING
Arrows indicate pouring of juice in the first-day experimental training.

represents the process followed. The liquid in A was poured into D, and the liquid in B was poured into C. The examiner stated, "I know that you all like juice; which one (C or D) would you take if you wanted more juice to drink?" The children pointed to the glass they wanted. The liquid was then poured back into glasses A and B and the subjects given the amount they chose to drink. A child who chose the correct glass was asked to give an explanation. This procedure was repeated two more times, using different pairs of unequal glasses. On the first trial, almost without exception, non-conserving subjects chose the narrow glass and conserving subjects the wide glass.

h. Experimental training: second day. The second session involved a variation to prevent the subjects from concluding that the wide jar always contained the largest amount. Each child received two trials (conducted in group setting); on one trial the largest amount was poured into the wide glass and on the other it was poured into the narrow glass. Subjects answering correctly were asked to give explanations.

i. Conservation posttest. The posttest was identical to the pretest, except that the orange balls were changed into a cup and the green balls into a cross.

j. Extinction items. These questions were administered to all experimental, control, and conserving subjects who gave correct predictions to posttest Questions 1 (juice-narrow) and 5 (sand-narrow). Following the correct prediction on these questions, the experimenter returned the glass he had just poured out of to his lap and replaced it on the table with a glass that was similar in all respects to the one removed except for a thick glass bottom. The juice in the narrow glass was poured back into the "fake" glass and the discrepancy in levels pointed out to the subject. The subject was given a chance to respond and then asked to explain the discrepancy.

k. Examiners. Five experimenters assisted the principal investigator and in no instance did a posttest examiner know whether the subject he was testing was in the experimental or control group.

C. RESULTS

1. Induction of Conservation of Substance

Table 1 shows the main results of the experimental induction. Twelve of the 24 experimental subjects who received training showed some evidence of conservation on the posttest, as opposed to only one of the control subjects. The criterion for evidence of conservation was at least one correct prediction with an adequate explanation. The 12 experimentally trained subjects who evidenced conservation on the posttest gave a total of 38 "same" responses—84.2 per cent of these responses were accompanied by an adequate explanation. The minimal criterion of one same response was present in only one case. A significant difference between the experimental and control subjects was found by chi square analysis ($\chi = 11.52, p < .01$).

TABLE 1
ACQUISITION OF CONSERVATION

Group	Evidence of conservation	
	+	—
Experimental ($N = 24$)	12	12
Control ($N = 26$)	1	25

Table 2 presents the number of experimentally trained subjects who reached a criterion of four correct predictions on the posttest. A chi square analysis reveals that the difference between experimental and control groups is significant ($\chi = 3.93$, $p < .05$).

TABLE 2
EXPERIMENTAL Ss EXHIBITING FOUR SAME PREDICTIONS

Group	Four same predictions	
	+	-
Experimental ($N = 24$)	5	19
Control ($N = 26$)	0	26

The experimental group gave a total of 41 correct conservation predictions in the posttest and the control group a total of three. A nonparametric median test showed this difference to be significant at the .001 level.

2. *Transfer to Substances Not Used in Experimental Training*

The criterion for acquisition of conservation in a specific substance (clay, sand, juice) was at least one correct prediction with an adequate explanation. Table 3 shows that conservation responses were most often evidenced on

TABLE 3
POSTTEST CONSERVATION RESPONSES IN JUICE, SAND, AND CLAY

Evidence of conservation	Juice (1 question)	Sand (2 questions)	Clay (2 questions)
+	6	8	9
-	6	4	3

clay, although clay was not used in training and does not share with the training substance (juice) the property of being pourable.

Transfer of conservation from one substance to another for the experimentally trained subjects is shown in Table 4. The transfer between clay and sand is significant (Fisher exact test, $p < .025$), but not between juice and the other substances. The number of questions differed (one for juice, two each for sand and clay), and this complicates the analysis.

3. *Responses to Extinction Questions*

Table 5 summarizes the extinction data. A response was defined as relinquished only if the subject stated that the glass with the thick bottom contained more of the substance than did the other glass. Every other response was defined as a resisting response. Three experimental subjects responded with a wrong prediction to the first juice question and were not administered

TABLE 4
TRANSFER OF CONSERVATION FOR EXPERIMENTAL Ss

			Clay	
		+	—	
Sand	—	6		2
	—	3		13
			Sand	
		+	—	
Juice	+	3		3
	—	5		13
			Clay	
		+	—	
Juice	+	4		2
	—	5		13

TABLE 5
EXPERIMENTAL CONSERVERS AND CONSERVATION GROUP RESPONSES TO EXTINCTION

Response	Experimental	Conservation
Resisted on both questions	2	6
Relinquished on both questions	0	2
Relinquished on first, resisted on second question	1	3
Took first item (relinquished or resisted) and gave wrong prediction on last conservation question	5	1
No more same predictions after first extinction question	1	0
Only took second extinction question		
Relinquished	2	0
Resisted	1	0

the first extinction item. Six experimental subjects gave a wrong prediction on the last conservation question after taking the first extinction item. Five of these subjects did give correct predictions to other questions, indicating that the concept was not totally extinguished.

Only five of the experimentally trained conserving subjects reached a level of conservation comparable to that shown by the conserving group who had conservation before the experiment began. The performance of these five subjects on extinction was as follows: (a) two resisted twice; (b) one relinquished on the first, resisted on the second; (c) one only took the second and relinquished; and (d) one only took the second and resisted. Although not statistically significant because of the small number, this performance resembles the conservation group's reaction to extinction.

4. *Relevance of Explanatory Set*

The explanatory set score was not related to acquisition of conservation for the experimentally trained subjects. The difference between means of acquiring *versus* nonacquiring experimental subjects on the explanation questions approached significance ($p < .10$, one-tailed test).

D. DISCUSSION AND CONCLUSION

The data show that the experimental training was influential in accelerating acquisition of the concept of conservation of substance. Five experimental subjects gave at least four correct predictions, while seven experimental subjects showed significant growth in the development of the concept.

The experimentally induced concept was not restricted to the substance used in training. This transfer phenomenon in respect to clay is even more remarkable in view of the finding by Hyde, reported by Lovell (8), that some children who conserved with liquid failed to conserve with clay.

The stability of the experimentally induced concept, measured by the child's reaction when faced with an apparent conservation contradiction, appears similar to the stability evidenced by the conservation group who had the concept before the experiment started. This statement is based on the performance of the five experimental subjects who acquired a level commensurate with the conserving group. Smedslund (12) applied a somewhat different extinction item to 11 subjects who acquired conservation by external reinforcement, and all of them extinguished.

The data from induction, transfer, and extinction indicated that the experimentally induced concept is like the concept that children acquire "naturally."

The main limitation of this study is the failure to isolate the variables in the experimental training responsible for the induction of conservation. The experimental training was standardized and, in light of the difficulty other investigators have had in producing the concept, it took place over a relatively short period of time. Subsequent research will have to manipulate the observed variables operating in the training.

One criticism of attempts to accelerate conservation has been that the experimental training provides practice in the use of *same* responses, which children are sometimes reluctant to use. It is important to note that nothing in the experimental training would contribute to the increase in *same* predictions if the concept of conservation of substance was not acquired. Training was in the conservation of *inequalities*, and children had more practice in giving *more* and *less* responses than they had with *same* predictions.

In the conservation training, the subjects had the expectation that the

narrow container had more juice, and this expectation was reversed. Then, in order to obtain more juice, they had to integrate the elements of the conservation situation. A logical explanation was offered in the presence of conflicting perceptual cues. This condition was motivating and resulted in concentrated attention.

In Piagetian terms, the child was maintained in a condition of socialization—a situation that required coordination of other viewpoints. The most important aspect of the training consisted of the demands made on the child by the training situation. The subject's existing cognitive structure could not adequately cope with these demands, and therefore these structures were in a state of disequilibrium.

Twelve experimental Ss acquired what Piaget describes as reversibility—the ability to reverse mentally the transformed shape to its original state. The training provided practice in this important task. The child was given the opportunity to practice reversibility in the presence of an empirical referent and this practice probably assisted the child when he had to perform a similar task in the absence of an empirical referent.

E. SUMMARY

Twenty-four nonconserving subjects received experimental training designed to induce conservation of substance. Twenty-six matched control subjects were not trained. Training was in the conservation of inequalities of liquid in a situation wherein the subject's expectation of an event was reversed. The child had to integrate the elements of the conservation situation to obtain a desired reward. Twelve of the experimental subjects showed evidence of acquiring conservation. Five of these subjects gave at least four of five correct conservation predictions. The concept transferred to substances (clay, sand) not used in experimental training. The five experimental subjects with four correct predictions performed similarly to subjects possessing conservation before the experiment on an extinction item. The theoretical implications of the results were briefly discussed.

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EFFECT OF DESOXYCORTICOSTERONE ACETATE (DOCA) ON THE STARTLE RESPONSE IN THE RAT*¹

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A. INTRODUCTION

The effects of adrenal steroids on brain excitability have been extensively studied by Woodbury and his associates (2). However, there has been relatively little effort devoted to the experimental study of the adrenal steroids on behavior. It has been shown (2) that the brain excitability of the rat, as measured by electroconvulsive shock threshold, is significantly lowered six hours after the animal has received a dose of 2 mg of desoxycorticosterone acetate (DOCA). It is reasonable to suspect that the reduced brain excitability might be reflected in behavior. It was the purpose of this experiment to determine whether injections of DOCA influence the magnitude of the startle response in the rat.

B. METHOD

1. *Subjects*

The subjects were 50 male albino rats from the colony of the Carnegie Institute of Technology. The *Ss* were 90 to 93 days of age at the beginning of the experiment.

2. *Apparatus*

The apparatus was a slightly modified form of the one used by Brown, Kalish, and Farber (1). The sensing unit was a postage scale (Hanson Model 1509, five pound capacity). The platform, dial, pointer, and protective glass were removed. The platform was replaced with a Plexiglas box, $2\frac{3}{4} \times 6 \times 4$ inches. The box floor was composed of $\frac{1}{16}$ -inch brass rods spaced $\frac{1}{4}$ -inch apart. When an *S* was placed in the confining box and subjected to a sudden auditory stimulus, *S's* startle reaction depressed the platform. The platform

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movements were transmitted by thread and pulley to a moving paper recorder system. A six mm blank starting pistol held 48 inches from *S* produced the startle stimulus.

C. PROCEDURE

Five days prior to the first day of startle, *Ss* were placed in individual cages and given food and water *ad lib*.

On the morning of the experimental day the *Ss* were divided into five groups and subjected to the following procedure. Group I was the normal control and remained in the home cage undisturbed. Group II served as a saline control and was given a subcutaneous injection of .4 ml of physiological saline. Group III was given a subcutaneous injection of desoxycorticosterone acetate, 0.5 mg per 100 grams of body weight. Group IV was given DOCA, 1.0 mg per 100 grams of body weight, and Group V, 2. mg per 100 grams of body weight. After the injection, the *Ss* were returned to their home cages. Six hours after the injections the *Ss* received the following startle procedure.

S was taken to the startle room, placed in the confining box of the apparatus, and given 1.5 minutes of acclimatization time. The blank pistol was then fired. The initial shot served to settle *S* down. The *S* characteristically ceased all random movements and remained quite still on all four feet in the cage and did not change position appreciably during the rest of the trial. Five more shots were fired at intervals of 30 seconds and the amount of startle was automatically recorded.

D. RESULTS AND DISCUSSION

The mean of the mean startle response for each of the groups was as follows: Control, 7 mm; Salt Control, 5.9 mm; .5 mg, 5.9 mm; 1.0 mg, 6.4 mm; 2.0 mg, 4.0 mm. The mean of the largest startle for each of the groups was as follows: Control, 11.0 mm; Salt Control, 10.6 mm; .5 mg, 10.5 mm; 1.0 mg, 11.7 mm; 2.0 mg, 7.9 mm.

Analysis of variance on both of these measures indicated that the differences among the groups were not statistically significant. A *t*-test of the two extreme groups, control and 2.0 mg, does not approach statistical significance.

Although the dosage used here will reliably affect other behavior (1.0 mg per 100 grams of body weight will increase consumption of water and 3 per cent salt solution),² it does not appear to reduce the magnitude of the startle response.

E. SUMMARY

In summary, although there is good reason to believe, on the basis of the fact that DOCA significantly reduces brain excitability, that DOCA would

² Moyer, unpublished data.

reduce the magnitude of the startle response, these results do not support that hypothesis. However, the trend of the data is in the right direction and a more sensitive dependent variable might reveal reliable differences.

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EFFECT OF ADRENALECTOMY ON THE STARTLE RESPONSE IN THE RAT*¹

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A. INTRODUCTION

There is good reason to believe that the startle response might be influenced by adrenalectomy. It has been shown (7) that the electroconvulsive shock threshold is lowered by 14 per cent after adrenalectomy. Thus, brain excitability is increased and it might be expected that the startle response would be facilitated. Woodbury (6) summarizes several lines of evidence to indicate that adrenal cortex hypofunction results in such symptoms as "nervousness and hyperexcitability." Moyer and Bunnell (3, 5) have shown that adrenalectomy increases emotional elimination in the open field, but adrenal demedullation does not.

The present experiment was carried out to determine whether or not the startle response is facilitated by adrenalectomy.

B. METHOD

1. *Subjects*

The subjects were 30 female albino rats from the colony of the Carnegie Institute of Technology. All *Ss* were 86 days of age at the beginning of the experiment.

2. *Apparatus*

The apparatus was a slightly modified form of the one used by Brown, Kalish, and Farber (1). The sensing unit was a postage scale (Hanson Model 1509, five pound capacity). The platform, dial, pointer, and protective glass were removed. The platform was replaced with a Plexiglas box, $2\frac{3}{4} \times 6 \times 4$ inches. The box floor was composed of $\frac{1}{16}$ -inch brass rods spaced $\frac{1}{4}$ -inch apart. When an *S* was placed in the confining box and subjected to a sudden auditory stimulus, *S's* startle reaction depressed the platform. The

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platform movements were transmitted by thread and pulley to a moving paper recorder system. A six mm blank starting pistol held 48 inches from *S* produced the startle stimulus.

C. PROCEDURE

Ten days prior to the beginning of the testing period, 12 of the animals were operated on and a bilateral adrenalectomy was performed following the procedure described in Farris and Griffith (2). Ether was used as an anesthetic. A sham operation was performed on nine *Ss*. The procedure for this operation was exactly the same as for the adrenalectomy. An incision was made in the skin and in the muscle tissue so that the adrenal glands were exposed. They were not disturbed, however. During this time, the non-operated control group of nine *Ss* remained undisturbed in their home cages. Food and water were available to all *Ss ad lib*. All *Ss* had salt solution available after the operation.

On the day of startle, *S* was taken to the startle room, placed in the confining box of the apparatus and given 1.5 minutes of acclimatization time. The blank pistol was then fired. The initial shot served to settle *S* down. The *S* characteristically ceased all random movements and remained quite still on all four feet in the cage and did not change position appreciably during the rest of the trial. Five more shots were fired at intervals of 30 seconds and the amount of startle was automatically recorded.

Salt water was taken from the *Ss* in the adrenalectomy group on the day following the startle experience. A record was kept of how long it took the *Ss* to die. If an *S* did not die within 15 days, its data were discarded on the assumption that the adrenalectomy was not complete (3). Three *Ss* were discarded for this reason, leaving a total *N* of nine in the group.

D. RESULTS AND DISCUSSION

The mean of the mean startle response for the three groups was as follows: Adrenalectomy, 8.7 mm; Sham-operated, 6.0 mm; and Control, 10.0 mm. The mean of the largest startle for each of the three groups was Adrenalectomy, 13.7 mm; Sham-operated, 10.8 mm; and Control, 17.0 mm.

Analysis of variance on both of these measures indicates that the differences among the groups are not statistically significant.

It is clear from these data that adrenalectomy does not produce large changes in the startle response of the rat as measured in this experiment. However, there is considerable variability in these data and it is possible that a more precise measure would reveal differences obscured here by intersubject variability.

This study dealt with the effect of adrenalectomy on an initial series of startle responses. Further work might be carried out using the well habituated startle response as a dependent variable. The habituated startle response is more stable than the initial startle. Further, the magnitude of the habituated startle response is not as great as the initial startle, and therefore any facilitating effects of adrenalectomy would be more readily apparent.

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